5-1520-234-10/990

TM 55-1520-234-10

TECHNICAL MANUAL

OPERATORS MANUAL

ARMY MODEL AH-1S (MOD) HELICOPTER

This copy is a reprint which includes current pages from Changes 1-27.

HEADQUARTERS, DEPARTMENT OF THE ARMY
17 NOVEMBER 1976

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----	4-34.1/4-34.2
4-35 and 4-36	4-35 and 4-36

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3-17 and 3-18	3-17 and 3-18

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8-3 and 8-4	8-3 and 8-4
8-7 through 8-12	8-7 through 8-12
- - -	8-12A/8-12B

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Remove pages	Insert pages
a through c/d	a through c/d
i and ii	i and ii
1-1 and 1-2	1-1 and 1-2
2-3 through 2-8	2-3 through 2-8
2-13 and 2-14	2-13 and 2-14
2-17 through 2-20	2-17 through 2-20
2-23 through 2-28	2-23 through 2-28
---	2-28A/2-28B
2-31 through 2-34	2-31 through 2-34
2-34A and 2-34B	2-34A and 2-34B
2-35 and 2-36	2-35 and 2-36
2-36A/2-36B	---
2-37 through 2-39/2-40	2-37 and 2-38
3-17 and 3-18	3-17 and 3-18
4-27 through 4-30	4-27 through 4-30
4-35 and 4-36	4-35 and 4-36
4-39 and 4-40	4-39 and 4-40
5-1 through 5-6	5-1 through 5-6
5-6A and 5-6B	---
5-7 through 5-9/5-10	5-7 and 5-8
6-1	6-1 and 6-2
6-4	6-4
6-5 and 6-6	6-5 and 6-6
6-10N through 6-10T	6-10N through 6-10T
6-15 through 6-20	6-15 and 6-16
7-1 and 7-2	7-1 and 7-2
7-5 and 7-6	7-5
7-7 and 7-8	7-8
7-9 and 7-10	7-9 and 7-10
---	7-10A/7-10B
---	7-14A and 7-14B
7-15 and 7-16	7-15 and 7-16
8-1 through 8-28	8-1 through 8-19/8-20
9-1 through 9-15/9-16	9-1 through 9-11/9-12
A-1 and A-2	A-1 and A-2
Index 1 through Index 8	Index 1 through Index 4

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Remove pages	Insert pages
5-1 and 5-2	5-1 and 5-2
9-12A/9-12B	9-12A/9-12B
9-13 and 9-14	9-13 and 9-14

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Remove Pages	Insert Pages
5-5 through 5-8	5-5 through 5-8
8-21 and 8-22	8-21 and 8-22
8-22A/8-22B	8-22A and 8-22B
9-3 and 9-4	9-3 and 9-4
9-9 and 9-10	9-9 and 9-10

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Chapter 2	2-1 thru 2-4	2-1 thru 2-4
	2-15 thru 2-18	2-15 thru 2-18
	2-23 and 2-24	2-23 and 2-24
	2-29 and 2-30	2-29 and 2-30
	2-34A and 2-34B	2-34A and 2-34B
Chapter 4	4-3 and 4-4	4-3 and 4-4
	4-29 and 4-30	4-29 and 4-30
Chapter 5	5-1 thru 5-6A/5-6B	5-1 thru 5-6B
Chapter 6	6-1 thru 6-4	6-1 thru 6-4
	6-11 and 6-12	6-11 and 6-12
	6-17 thru 6-20	6-17 thru 6-20
Chapter 8	8-7 and 8-8	8-7 thru 8-8A/8-8B
	8-9 thru 8-12	8-9 thru 8-12
	8-15 and 8-16	8-15 and 8-16
Chapter 9	9-5 thru 9-8	9-5 thru 9-8A/9-8B
	9-11 thru 9-12A/9-12B	9-11 thru 9-12A/9-12B
	9-13 thru 9-15/9-16	9-13 thru 9-15/9-16

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Chapter 2	2-5 thru 2-8	2-5 thru 2-8
	2-10	2-10
	2-13 and 2-14	2-13 and 2-14
	2-27 thru 2-32	2-27 thru 2-32
Chapter 4	4-1 thru 4-2B	4-1 thru 4-2B
Chapter 5	5-1 and 5-2	5-1 and 5-2
Chapter 8	8-3 and 8-4	8-3 and 8-4
		8-4A/8-4B
	8-7 thru 8-10	8-7 thru 8-10

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Chapter 8	8-5 and 8-6	8-5 and 8-6

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1. Warning Page is superseded as follows.

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	Remove pages	Insert pages
Chapter 2	2-3 and 2-4	2-3 and 2-4
	2-10 thru 2-14	2-10 thru 2-14
	2-17 thru 2-20	2-17 thru 2-20
	2-23 and 2-34	2-23 thru 2-34A/2-34B
	2-35 and 2-36	2-35 and 2-36
	2-39/2-40	2-39/2-40
Chapter 3	3-1 and 3-2	3-1 and 3-2
	3-3 and 3-4	3-4
	3-11 and 3-12	3-11 and 3-12
	3-15 thru 3-17/3-18	3-15 thru 3-18
Chapter 4	4-1 thru 4-2A/4-2B	4-1 thru 4-2B
	4-3 and 4-4	4-3 and 4-4
	4-11 and 4-12	4-11 and 4-12
	4-15 thru 4-18	4-15 thru 4-17/4-18
	4-19 thru 4-24	4-19 thru 4-24
	4-27 and 4-28	4-27 thru 4-28A/4-28B
	4-29 thru 4-38	4-29 thru 4-38
Chapter 5	5-1 thru 5-9/5-10	5-1 thru 5-9/5-10
Chapter 6	6-1 and 6-2	6-1
	6-4 thru 6-10	6-4 thru 6-10T
	6-11 thru 6-20	6-11 thru 6-20
Chapter 7	7-15 and 7-16	7-15 and 7-16
	7-21 thru 7-44	7-21 thru 7-44
Chapter 8	8-3 thru 8-12	8-3 thru 8-12
	8-25 and 8-26	8-25 and 8-26
Chapter 9	9-1 and 9-2	9-1 and 9-2
	9-3 and 9-4	9-3 and 9-4
	9-9 and 9-10	9-9 thru 9-10A/9-10B
	9-11 thru 9-14	9-11 thru 9-14

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WARNING

Personnel performing operations, procedures, and practices which are included or implied in this manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause serious injury or loss of life. Procedures outlined in paragraph 1-6, AR 40-46 are applicable.

STARTING ENGINES

Coordinate all cockpit actions with ground observer. Ensure that rotors and blast area are clear and fire guard is posted.

GROUND OPERATION

Engine will be started and helicopter operated only by authorized personnel. Reference AR95-1.

GROUNDING HELICOPTER

The helicopter should be electrically grounded when parked and will be grounded during refueling operations.

HIGH VOLTAGE

Serious burns and/or electrical shock can result from contact with exposed electrical wires or connections.

FIRE EXTINGUISHER

Exposure to high concentrations of monobromotrifluoromethane (CF3br) extinguising agent or decomposition products should be avoided. The agent should not be allowed to come in contact with the skin, as it may cause frostbite or low-temperature burns.

When helicopter is to be parked where ambient temperature equals or exceeds 90°F (32°C), the fire extinguisher shall be removed until the next mission.

Should an extinguisher be left in the helicopter inadvertently during a high temperature period, the extinguisher shall be weight checked prior to the next mission.

ARMAMENT

Loaded weapons, or weapons being loaded or unloaded, shall be pointed in a direction which offers the least exposure to personnel or property in the event of an accidental firing. Personnel should remain clear of a hazardous area (forward or aft) of all loaded weapons. Any rotation of the turret or wing gun pod machine gun barrels or pushing the turret grenade launcher aft may cause the weapon to fire.

VERTIGO

The rotating beacon light should be turned off during flight through clouds to prevent sensations of vertigo as a result of reflections of the light on the clouds.

CARBON MONOXIDE

When smoke, suspected carbon monoxide fumes, or symptoms of anoxia exist, the crew should immediately ventilate cockpits and open canopy to intermediate position at 40 KIAS or below.

FUEL, OIL, AND HYDRAULIC FLUIDS

Turbine fuels and lubricating oils contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary. Prolonged contact may cause a skin rash. Prolonged contact with hydraulic fluid will cause burns. Refer to FM 10-68 when handling fuel.

When handling hydraulic fluid (MIL-H-83282), observe the following:

—Prolonged contact with liquid or mist can irritate eyes and skin.
—After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush them immediately with clear water.
—If liquid is swallowed, do not induce vomiting; get immediate medical attention.
—Wear rubber gloves when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator.
—When fluid is decomposed by heating, toxic gases are released.

ELECTROLYTE

Battery electrolyte is harmful to the skin and clothing. If potassium hydroxide is spilled on clothing or other material, wash immediately with clean water. If spilled on personnel, immediately start flushing the affected area with clean water. Continue flushing until medical assistance arrives.

ROTOR BLADES

Personnel shall stay clear of turning main and tail rotor blades. Wind gusts, coast down, or cyclic movement may cause the main rotor blade to flap down below the height of a person. Dangerous winds are created by the main rotor blades when blades are at operating rpm.

RADIOACTIVE MATERIALS

Self-luminous dials contain radioactive materials. If such an instrument is broken or becomes unsealed, avoid personnel contact.

NOISE LEVEL

Sound pressure levels in the helicopter during some operating conditions exceed the Surgeon Generals hearing conservation criteria as defined in TB MED251. Hearing protection devices, such as the aviator helmet, ear plugs, or ear muffs shall be worn by all personnel in and around the helicopter during operation.

WING STORES JETTISON

All jettison safety pins shall be installed when the helicopter is on the ground. Serious injury can result from accidental ground jettison. Safety pins shall be removed prior to flight. Failure to do so will prevent emergency jettison of wing stores.

CANOPY REMOVAL SYSTEM

Ground safety pins shall be installed in pilot and gunner canopy removal arming/firing mechanisms when the helicopter is on the ground. Pilot safety pin shall be removed prior to flight. Safety pins shall be installed during engine shutdown check. Debris may be expelled 50 feet outward when system is actuated. Pilot and gunner helmet visor should be down to prevent eye injury.

OPERATOR'S MANUAL

HELICOPTER, ATTACK AH-1S

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, U. S. Army Aviation Systems Command, ATTN: AMSAV-MPSD, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply will be furnished directly to you.

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CHAPTER 1

INTRODUCTION

1-1. General.

These instructions are for use by the operator. They apply to AH-1S helicopter.

1-2. Warnings, Cautions and Notes Definition.

Warnings, cautions and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING

An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure, practice, etc., which it is essential to highlight.

1-3. Description.

This manual contains the best operating instructions and procedures for AH-1S (MOD) helicopters under most circumstances. The observance of limitations, performance and weight balance data provided is mandatory. The observance of procedure is mandatory except when modification is required because of multiple emergencies, adverse weather, terrain, etc. Your flying experience is recognized, and therefore, basic flight principles are not included. **THIS MANUAL SHALL BE CARRIED IN THE HELICOPTER AT ALL TIMES.**

1-4. Appendix A, References.

Appendix A is a listing of official publications cited within the manual, applicable to and available for flight crews.

1-5. Index.

The index lists, in alphabetical order, every titled paragraph, figure, and table contained in this manual. Chapter 7, performance data, shall have an additional index within the chapter.

1-6. Army Aviation Safety Program.

Reports necessary to comply with the safety program are prescribed in AR 385-40.

1-7. Destruction of Army Materiel to Prevent Enemy Use.

For information concerning destruction of Army materiel to prevent enemy use, refer to TM 750-244-1-5.

1-8. Deleted.

1-9. Forms and Records.

Army aviators flight record and helicopter maintenance records which are to be used by crewmembers are prescribed in DA PAM 738-751 and TM 55-1500-342-23.

1-10. Deleted.

1-11. Explanation of Change Symbols.

Changes, except as noted below, to the text and tables, including new material on added pages, are indicated by a vertical line in the outer margin extending close to the entire area of the material affected; exception: pages with emergency markings, which consist of black diagonal lines around three edges, may have the vertical line or change symbol placed along the inner margins. Symbols show current changes only. A miniature pointing hand symbol is used to denote a change to an illustration. However, a vertical line in the outer margin, rather than miniature pointing hands, is utilized when there have been extensive changes made to an illustration. Change symbols are not utilized to indicate changes in the following:

a. Introductory material.

b. Indexes and tabular data where the change cannot be identified.

c. Blank space resulting from the deletion of text, an illustration, or a table.

d. Correction of minor inaccuracies, such as spelling, punctuation, relocation of material, etc., unless such correction changes the meaning of instructive informati and procedures.

1-12. Helicopter Designation System.

The designation system prescribed by AR70-5 used in helicopter designations as follows:

AH-1S

Series Symbol
Design Number
Helicopter (Basic Mission)
Attack (Modified Mission)

1-13. Use of Shall, Will, Should, and May.

Use "shall" whenever it is necessary to express a p vision that is binding. Use "should" and "ma whenever it is necessary to express non-mandatory p visions. "Will" may be used to express a declaratio purpose.

CHAPTER 2

HELICOPTER AND SYSTEMS DESCRIPTION AND OPERATION

Section I. HELICOPTER

2-1. General Description.

The AH-1S helicopter is a tandem seat, two-place (pilot and gunner), single engine helicopter. The maximum gross weight for takeoff is 10,000 pounds.

2-2. General Arrangement.

Figure 2-1 depicts the general arrangement of the items which are referred to in the exterior check paragraph of Chapter 8, Section II.

2-3. Principal Dimensions.

Figure 2-2 depicts the principal dimensions of the helicopter to the nearest inch.

2-4. Turning Radius.

Figure 2-3 depicts the minimum turning radius of the helicopter.

2-5. Fuselage.

The fuselage is that forward portion of the airframe which extends from the nose of the helicopter to the forward end of the tailboom. The fuselage is constructed of aluminum alloy skin and aluminum, titanium and fiberglass honeycomb beams. Honeycomb deck panels and a minimum of bulkheads attached to the main beams produce a box-beam structure. The main beams are the main primary structure and supports the engine, transmission, tailboom, landing gear, wings, fuel cells, turret, and telescopic sight unit.

2-6. Tailboom.

The tailboom is that portion of the airframe which is bolted to the fuselage and extends to the aft end of the helicopter. It is tapered semi-monocoque structure employing aluminum skins, honeycomb panels, longerons, and stringers. It supports the tail rotor, fin, and synchronized elevators. It, also, houses the tail rotor driveshaft and some electronic equipment. Forced air ventilation is provided for the electronic equipment cooling.

2-7. Wing.

The fixed cantilever wing provides additional lifting surfaces and supports the wing stores pylons. It is constructed of two main spars, ribs, aluminum and/or aluminum honeycomb skin. It has a span of 10 feet and 9 inches, (including tip), tapered airfoil, and a mean cord of 2 feet and 6 inches. Each wing has two pylons. The inboard pylons are fixed and the outboard pylons are articulated by hydraulic actuators. Both Inboard and Outboard pylons will each support 670 pounds of weight.

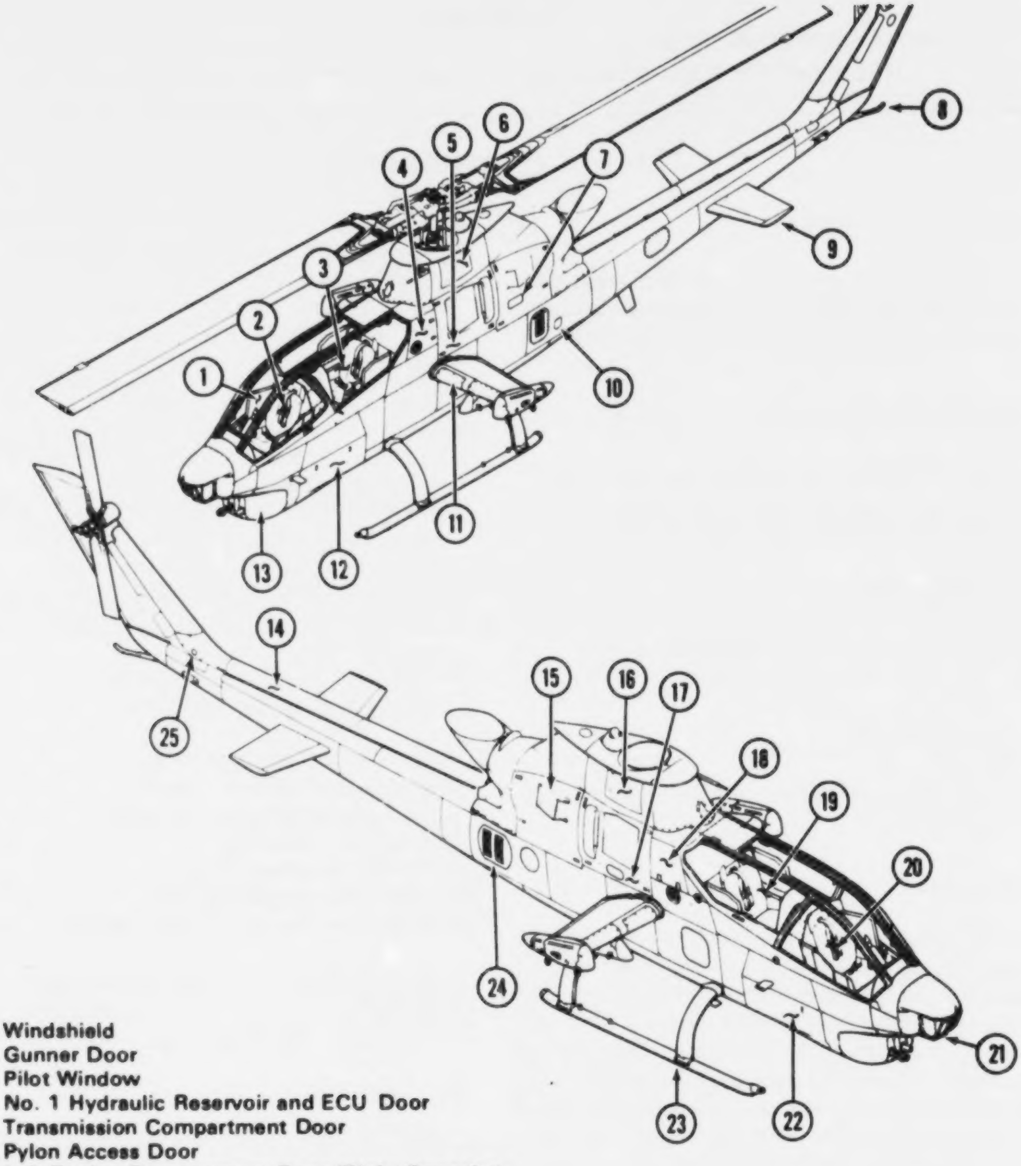
2-8. Landing Gear.

a. Main Landing Gear. The main landing gear consists of two aluminum lateral mounted arched crosstubes and two aluminum longitudinal skid tubes attached to the crosstubes. Each crosstube is enclosed in a fiberglass fairing for aerodynamic purposes. Each skid tube has a steel skid shoe on the bottom to minimize skid wear.

b. Tail Skid. The steel tubular type tail skid is installed on the aft end of the tailboom to protect the tail rotor blades during tail-low landing.

2-9. Canopy.

The canopy is the transparent panels on the upper portion of the fuselage which encloses the crew compartment. The canopy consists of one-piece windshield extending from the nose of the helicopter (over the gunner and pilot heads) to the pylon, the gunner door and pilot window on the left side, and the gunner window and pilot door on the right side. The canopy provides maximum field of view for the gunner. The pilot forward field of view is limited, but excellent in all other quadrants. The canopy removal system is used to remove the pilot and gunner windows and doors during emergencies. The system is covered in Chapter 2, Section II.



1. Windshield
2. Gunner Door
3. Pilot Window
4. No. 1 Hydraulic Reservoir and ECU Door
5. Transmission Compartment Door
6. Pylon Access Door
7. Left Engine Compartment Door (Right Opposite)
8. Tail Skid
9. Synchronized Elevator
10. External Power Receptacle
11. Wing
12. Ammunition Compartment Door
13. Turret
14. Tail Rotor Driveshaft Cover
15. Right Engine Compartment Cooling Air Inlet (Left Opposite)
16. Pylon Access Door
17. Transmission Compartment Door
18. No. 2 Hydraulic Reservoir and ECU Door
19. Pilot Door
20. Gunner Window
21. Telescopic Sight Unit
22. Ammunition Compartment Door
23. Landing Gear
24. Electrical Compartment Door (Battery)
25. 42° Gearbox Oil Sight Glass

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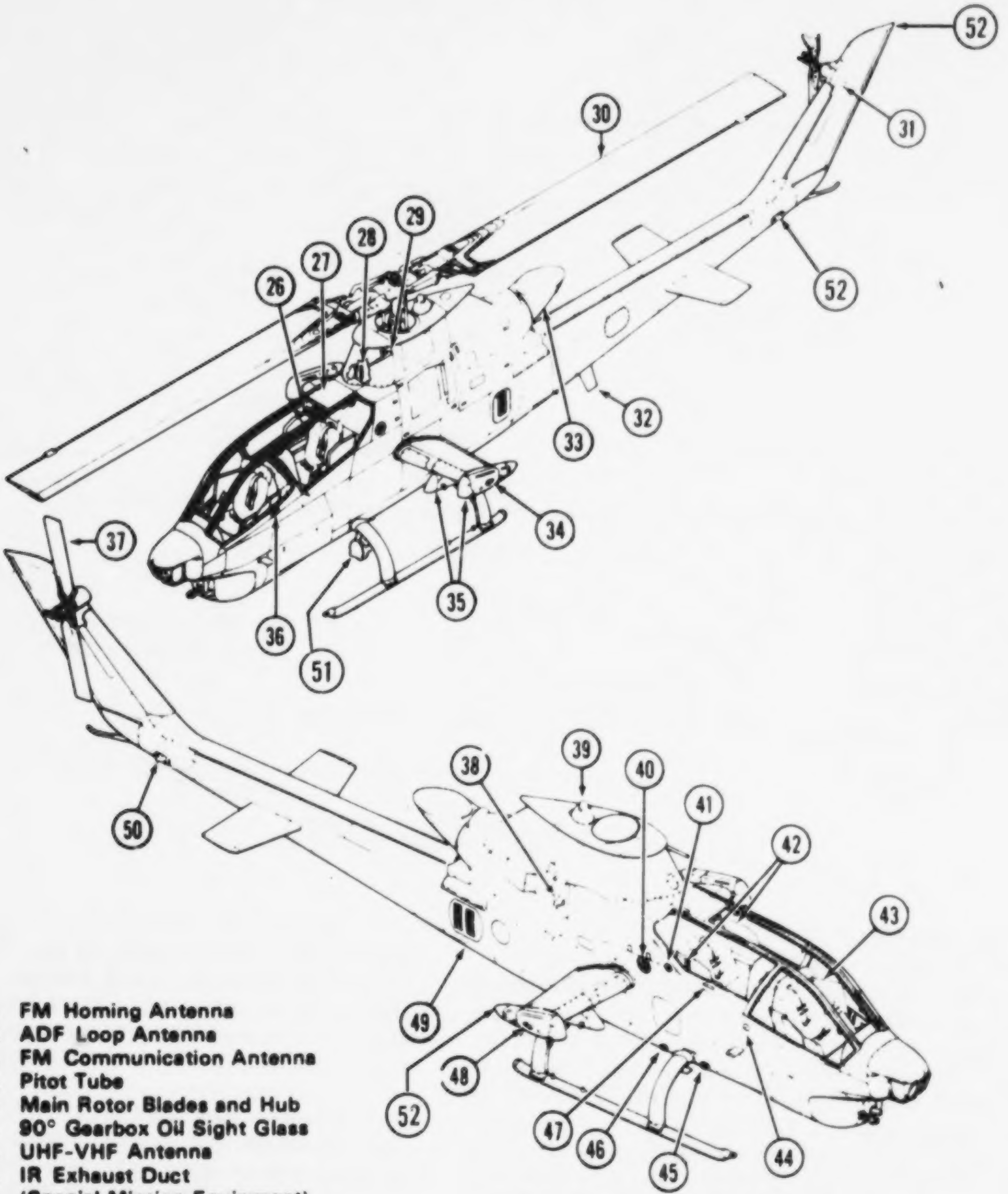
Figure 2-1. General arrangement (Sheet 1 of 2)



26. FM Homing Antenna
27. ADF Loop Antenna
28. FM Communication Antenna
29. Pitot Tube
30. Main Rotor Blades and Hub
31. 90° Gearbox Oil Sight Glass
32. UHF-VHF Antenna
33. IR Exhaust Duct (Special Mission Equipment)
34. Left Wing Position Light (Red)
35. Pylons
36. Gunner Door Latch
37. Tail Rotor Blades and Hub
38. Right Engine Air Inlet (Left Opposite)
39. Anti-Collision Light
40. Fuel Filler Cap
41. Ground Receptacle
42. Pilot Cockpit (Map) Lights
43. Gunner Cockpit (Map) Light
44. Left Static Port (Right Opposite)
45. Searchlight
46. Transponder Antenna
47. Pilot Door Latch and Padlock
48. Right Wing Position Light (Green)
49. ADF Sense Antenna
50. Right Tail Position Light (White) (Left Opposite)
51. Skid Landing Light
52. NVG Position Light

Figure 2-1. General Arrangement (Sheet 2 of 2)

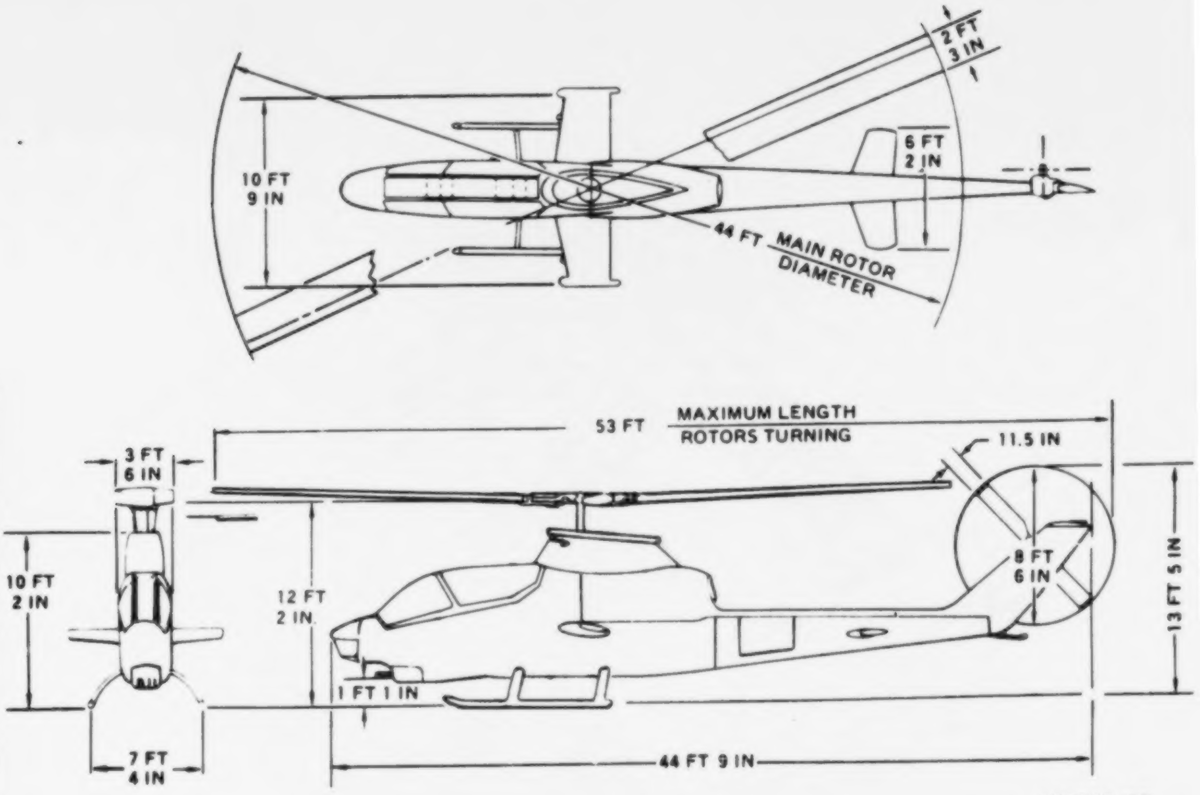


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Figure 2-2. Principal dimensions

2-10. Personnel Doors.

Both doors are hinged on top and swing outward and up to provide access. Both doors have supports incorporating locks to hold the door in the full open and intermediate positions. The lock is engaged only when the door handle is in the horizontal position. Both doors have an external padlock. Both doors are manually operated. The handle must be rotated to move the door from one position to another (closed, intermediate, full opened).

2-11. Seats — Pilot and Gunner.

a. Construction. Both seats, side-shoulder panels, and head protective panels are made of opaque armor material which provides armor protection. Both seats are equipped with contoured seat cushions and back supports made of foam and open mesh for vibration attenuation and crew comfort.

b. Pilot Seat. The pilot seat is vertically adjustable nonreclining type. The vertical adjustment is reclined at 15 degrees. The vertical height adjustment handle (figure 2-4) is under the left side of the seat. The seat is equipped with a lap safety belt and intertia reel shoulder harness.

c. Gunner Seat. The gunner seat is a fixed seat (non-adjustable and nonreclining). The seat is equipped with a lap safety belt and inertia reel shoulder harness. The seat also has arm rests.

d. Inertia Reel Shoulder Harness. An inertia reel shoulder harness is incorporated in the pilot and gunner seats with a manual lock-unlock control handle (figures 2-4 and 2-5). The handles are located to left front of each seat. With the control in the unlocked position, the reel cable will extend to allow the occupant to lean forward; however, the reel will automatically lock when helicopter encounters an impact force of two to three "g" deceleration. Locking of the reel can be

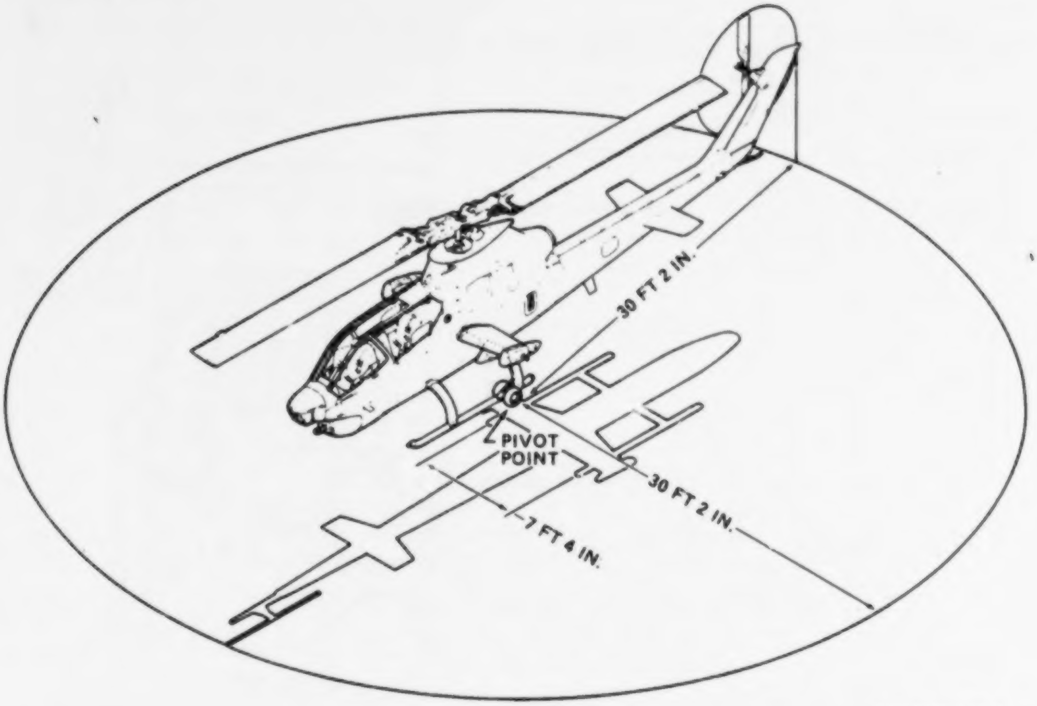


Figure 2-3. Turning radius

accomplished from any position and the reel will automatically take up the slack in the harness. To release the lock, it is necessary to lean back slightly to release tension on the lock and move the control handle to the lock and then unlock position. It is possible to have pressure against the seat back whereby no additional movement can be accomplished and the lock cannot be released. It this condition occurs, it will be necessary to loosen shoulder harness. Manual locking of the reel should be accomplished for emergency landings.

2-12. Crew Compartment Diagrams.

The upper forward portion of the fuselage is the crew compartment. Tandem seating is provided with the pilot elevated in the rear seat.

a. Pilot Station. Figure 2-4 depicts the locations of equipment in the pilot station.

b. Gunner Station. Figure 2-5 depicts the locations of equipment in the gunner station.

2-13. Instruments and Controls.

a. Pilot Instrument Panel. Figure 2-6 depicts the locations of instruments, switches, panels, and decals in the pilot instrument panel.

b. Gunner Instrument Panel. Figure 2-7 depicts the locations of instruments, switches, panels, and decals in the gunner instrument panel.

c. Other Instruments and Controls. These items are depicted on the pilot and gunner station diagrams (figures 2-4 and 2-5) or in the chapter/section which describes their related systems

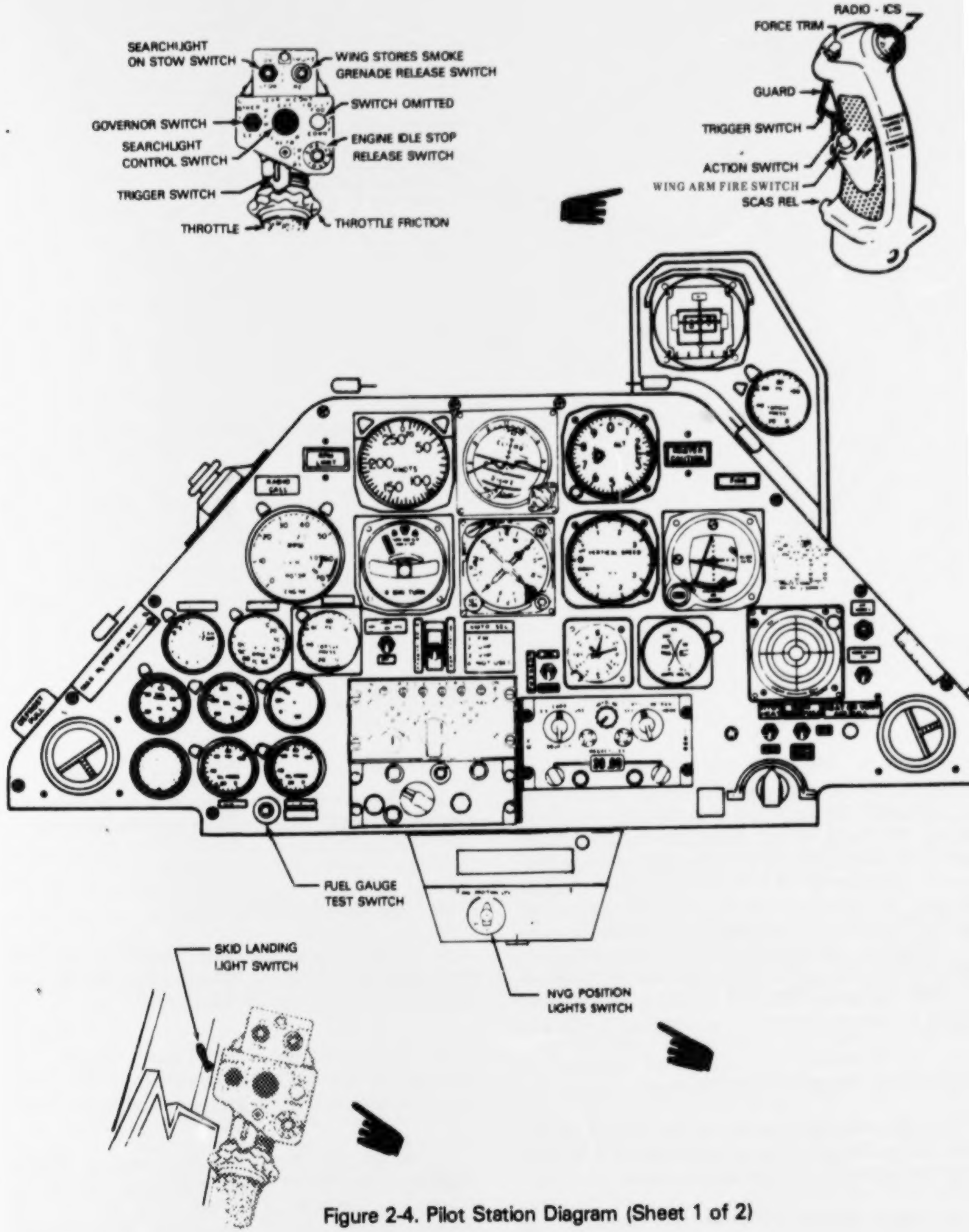

SEARCHLIGHT ON STOW SWITCH
WING STORES SMOKE GRENADE RELEASE SWITCH
SWITCH OMITTED
GOVERNOR SWITCH
SEARCHLIGHT CONTROL SWITCH
ENGINE IDLE STOP RELEASE SWITCH
TRIGGER SWITCH
THROTTLE
THROTTLE FRICTION
RADIO - ICS
FORCE TRIM
GUARD
TRIGGER SWITCH
ACTION SWITCH
WING ARM FIRE SWITCH
SCAS REL
250
200
150
100
50
KNOTS
FUEL GAUGE TEST SWITCH
NVG POSITION LIGHTS SWITCH
SKID LANDING LIGHT SWITCH

Figure 2-4. Pilot Station Diagram (Sheet 1 of 2)

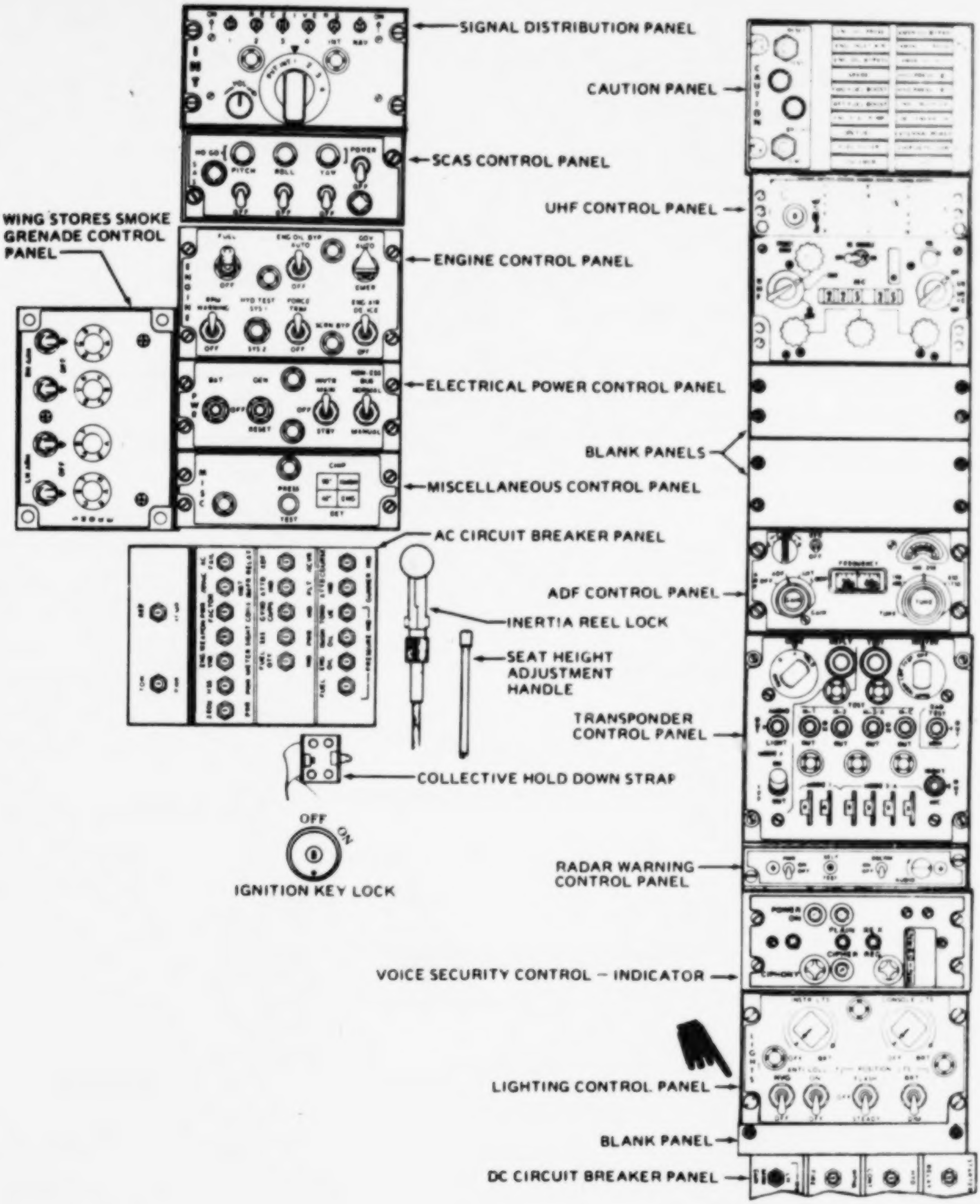

SIGNAL DISTRIBUTION PANEL
CAUTION PANEL
SCAS CONTROL PANEL
UHF CONTROL PANEL
WING STORES SMOKE GRENADE CONTROL PANEL
ENGINE CONTROL PANEL
ELECTRICAL POWER CONTROL PANEL
BLANK PANELS
MISCELLANEOUS CONTROL PANEL
AC CIRCUIT BREAKER PANEL
ADF CONTROL PANEL
INERTIA REEL LOCK
SEAT HEIGHT ADJUSTMENT HANDLE
TRANSPONDER CONTROL PANEL
COLLECTIVE HOLD DOWN STRAP
OFF
ON
IGNITION KEY LOCK
RADAR WARNING CONTROL PANEL
VOICE SECURITY CONTROL — INDICATOR
LIGHTING CONTROL PANEL
BLANK PANEL
DC CIRCUIT BREAKER PANEL

Figure 2-4. Pilot station diagram (Sheet 2 of 2)

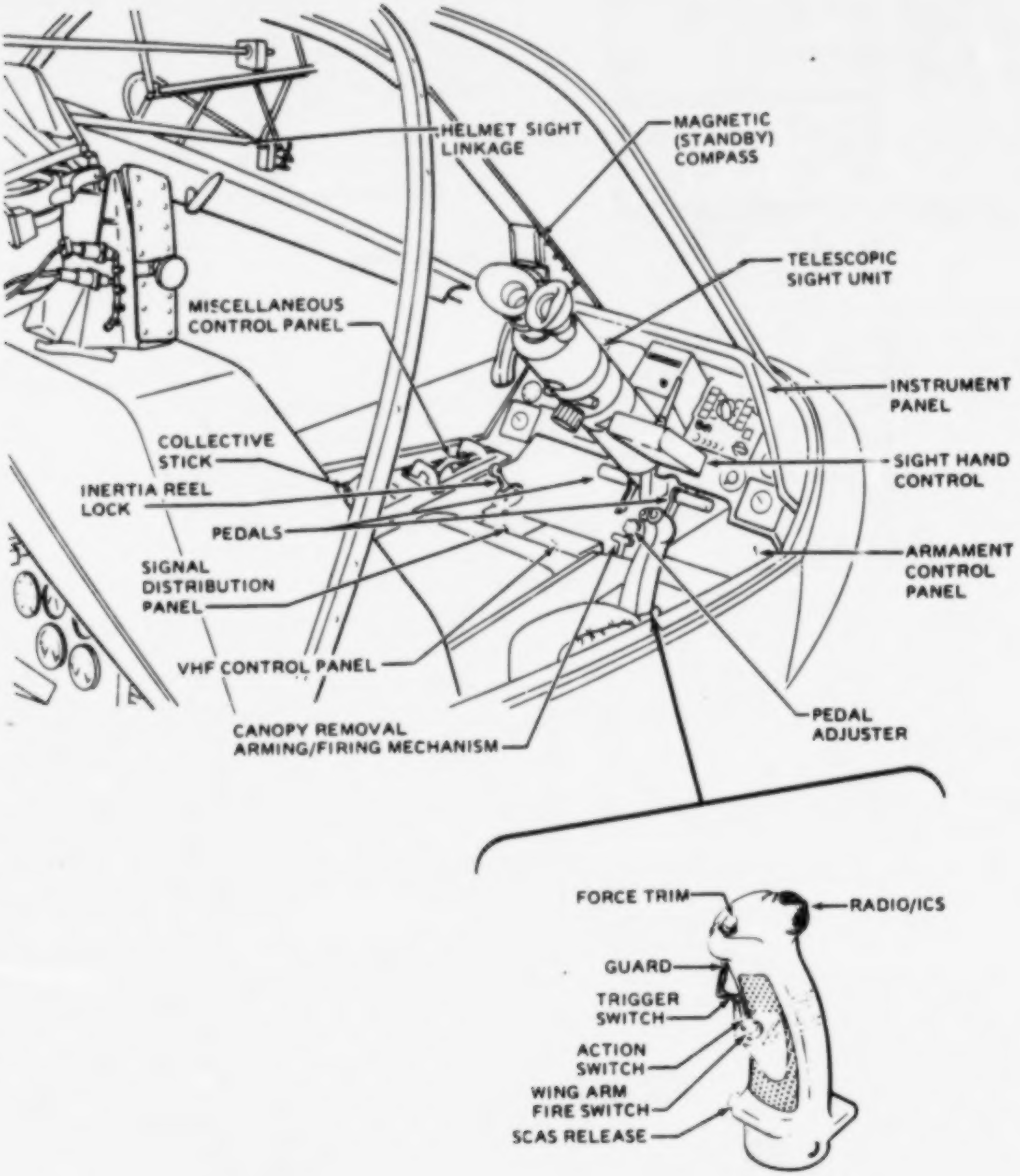

HELMET SIGHT LINKAGE
MAGNETIC (STANDBY) COMPASS
TELESCOPIC SIGHT UNIT
MISCELLANEOUS CONTROL PANEL
INSTRUMENT PANEL
COLLECTIVE STICK
SIGHT HAND CONTROL
INERTIA REEL LOCK
PEDALS
ARMAMENT CONTROL PANEL
SIGNAL DISTRIBUTION PANEL
VHF CONTROL PANEL
PEDAL ADJUSTER
CANOPY REMOVAL ARMING/FIRING MECHANISM
FORCE TRIM
RADIO/ICS
GUARD
TRIGGER SWITCH
ACTION SWITCH
WING ARM FIRE SWITCH
SCAS RELEASE
CYCLIC STICK
209900-365C

Figure 2-5. Gunner station diagram

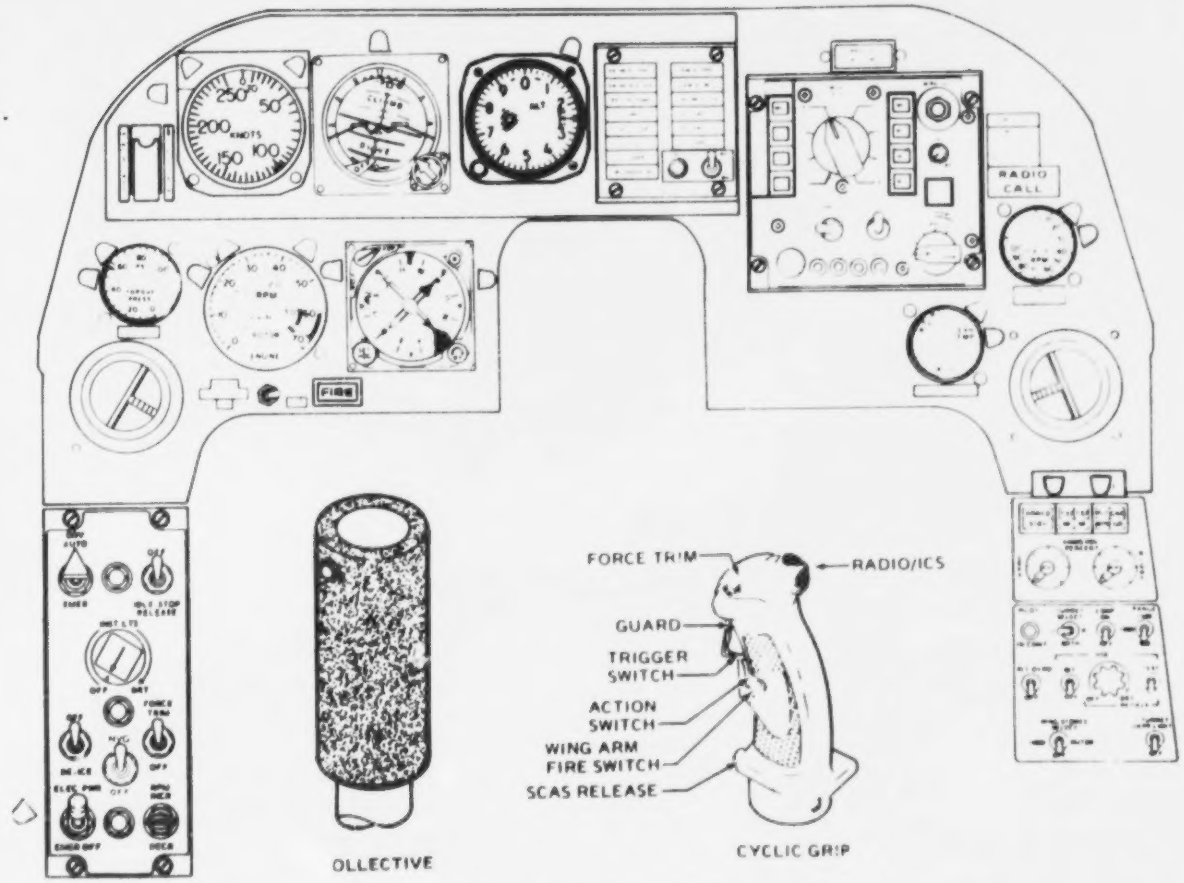

KNOTS
RADIO CALL
FIRE
FORCE TRIM
RADIO/ICS
GUARD
TRIGGER SWITCH
ACTION SWITCH
WING ARM FIRE SWITCH
SCAS RELEASE
OLLECTIVE
CYCLIC GRIP

Figure 2-7. Gunner instrument panel

Section II. EMERGENCY EQUIPMENT

NOTE

The emergency equipment locations and emergency procedures are covered in Chapter 9.

2-14. Portable Fire Extinguisher.

A portable hand-operated fire extinguisher is charged with monobromotrifluoromethane (CF3Br). It is located on the left side of the bulkhead behind the gunner seat. The extinguisher could discharge if temperature of 32°C (90°F) is exceeded.

2-15. First Aid Kit.

An aeronautical type first aid kit is located on the bulkhead behind the pilot seat.

2-16. Canopy Removal System.

Window cutting assemblies are mounted in the pilot and gunner window frames. The linear explosive is contained with the cutting assemblies. The cutting assemblies are controlled by the pilot or gunner arming/firing mechanisms. Rotating the arming/firing mechanism handle 90 degree counterclockwise (torque required 9 to 12 inch-pounds) will arm the cutting assemblies. Pulling the handle (28 to 32 pounds tension) will fire the percussion primer causing the cutting assemblies to be detonated. The explosive force will be outward and cut the four transparent panels out of their frames simultaneously. If handle has been rotated but not pulled, the handle can be rotated and the safety pin installed. DA Form 2408-13 entry required.

WARNING

Debris may be expelled 50 feet outward when system is actuated.

Section III. ENGINE AND RELATED SYSTEMS

2-17. Engine.

The helicopter is equipped with a model T53-L-703 engine (figure 2-8). The engine, in this installation, is derated by limitation of the helicopter transmission to 1290 shp (56 psi torque) for 30 minutes and 1134 shp (50 psi torque) for continuous operation at 6600 rpm. The engine compartment is cooled by ram ambient air.

2-18. Engine Protection.

a. Armor. Armor material is located on the left and right engine compartment doors to provide armor protection for the engine compressor, fuel control, oil filter, and fuel filter.

b. Missile. An infrared (IR) exhaust duct (figure 2-1) may be installed on the engine tailpipe to achieve engine exhaust IR signature reduction.

2-19. Air Induction System.

The helicopter is equipped with an automatic engine air inlet system. Ambient air enters the transmission compartment door air inlet, then routed through the foreign object damage (FOD) screen, and the particle separator to the engine air inlet.

a. Foreign Object Damage (FOD) Screen. The FOD screen is mounted around the particle separator on the forward end of the engine in the transmission compartment. The purpose of the screen is to prevent debris from entering the particle separator.

b. Particle Separator. The self-purging particle separator is located over the engine air inlet in the transmission compartment. The purpose of the separator is to remove particles from the engine inlet air and automatically eject them overboard.

2-20. Engine inlet Anti-Icing/Deicing System.

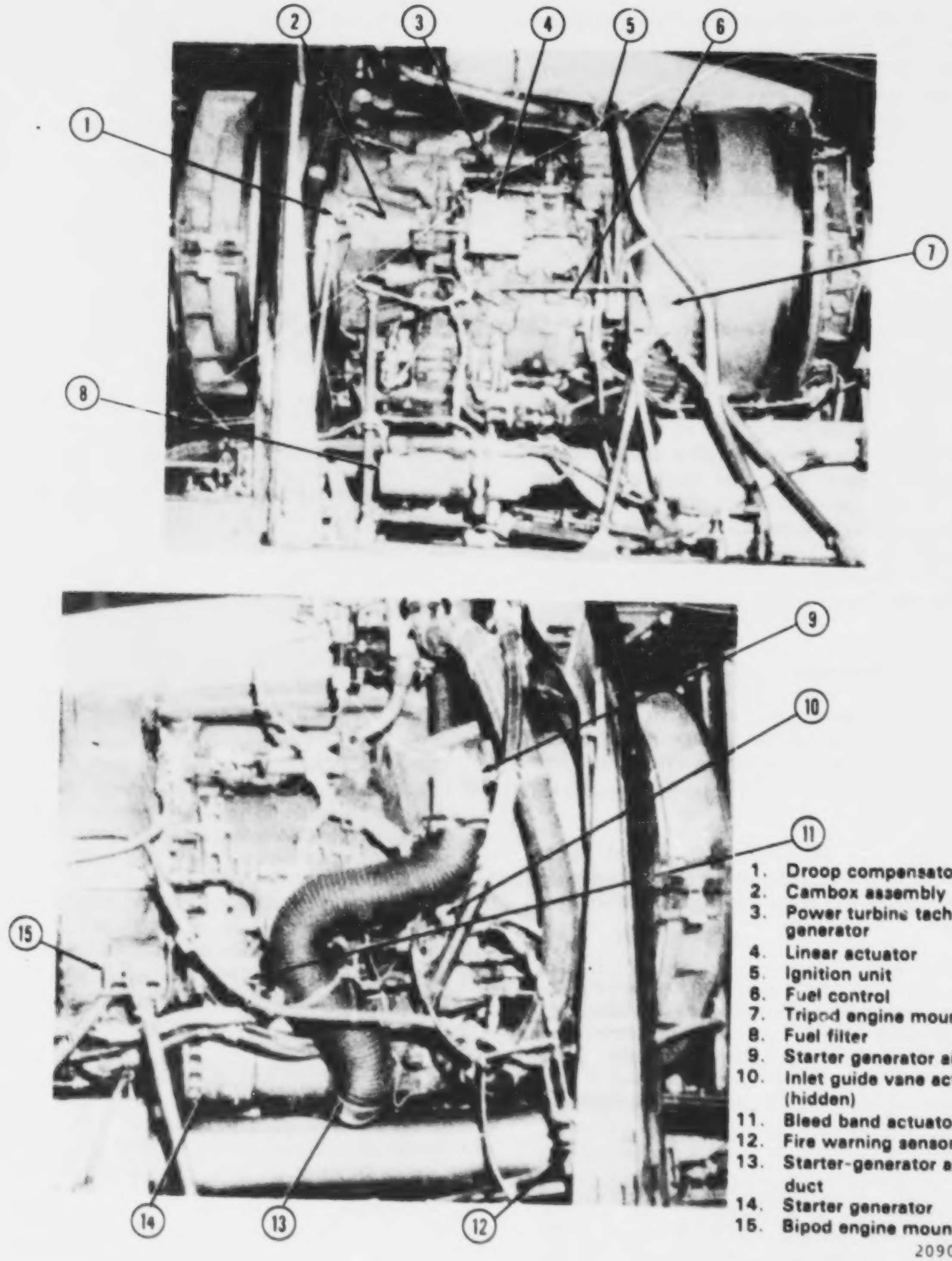
WARNING

The system will not deice or prevent icing of the FOD screen or particle separator. A power loss will occur if the formation of ice in the FOD screen or particle separator obstructs the flow of ambient air to the engine.

a. General. The system consists of a hot air solenoid valve on the engine, controlled by the pilot or gunner DE-ICE switch (figures 2-9 and 2-10), powered by the 28 Vdc essential bus, and protected by the ENG DE-ICE circuit breaker.

b. Purpose. The system prevents ice from forming in the engine air inlet.

c. Operation. If ice accumulation is suspected, the pilot or gunner DE-ICE switch is placed in the DE-ICE position. This action causes the hot air solenoid valve to route engine bleed air to the engine air inlet.



1. Droop compensator
2. Cambox assembly
3. Power turbine tachometer generator
4. Linear actuator
5. Ignition unit
6. Fuel control
7. Tripod engine mount
8. Fuel filter
9. Starter generator air intake
10. Inlet guide vane actuator (hidden)
11. Bleed band actuator
12. Fire warning sensor (hidden)
13. Starter-generator air intake duct
14. Starter generator
15. Bipod engine mount

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Figure 2-8. Engine

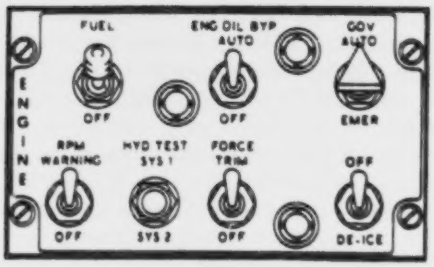

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Figure 2-9. Pilot engine control panel

NOTE

A rise in the turbine gas temperature (TGT) will occur when the pilot or gunner DE-ICE switch is in the DE-ICE position. Deice operation will become continuous if the hot air solenoid valve (ENG DE-ICE) circuit fails.

2-21. Engine Fuel Control System.

a. Engine Mounted Component. The fuel control assembly is mounted on the exterior left side of the engine. The assembly is controlled by the pilot or gunner throttle and GOV switch. The assembly consists of a metering section, a computer section, and an overspeed governor. The metering section pumps fuel to the engine. The computer section determines the rate of fuel delivery. The overspeed governor maintains a constant rpm.

b. Crew Controls.

(1) *Throttle.* Rotating the pilot or gunner grip type throttle (figure 2-4 and 2-5) to the full open position allows the overspeed governor to maintain a constant rpm. Rotating the throttle toward the closed position will cause the rpm to be manually selected instead of automatically selected by the overspeed governor. Rotating the throttle past the engine idle stop to the fully closed position shuts off fuel flow. A solenoid operated idle stop is incorporated to prevent inadvertent throttle closure. The idle stop is controlled by the pilot ENGINE IDLE STOP REL switch (figure 2-4) and the gunner IDLE STOP RELEASE switch (figure 2-10). The engine idle stop release circuit is powered by the 28 Vdc essential bus and protected by the IDLE STOP SOL circuit breaker. Friction can be induced into both throttles by rotating the pilot throttle friction ring (figure 2-4) counterclockwise. The ring is located on the upper end of the pilot throttle.

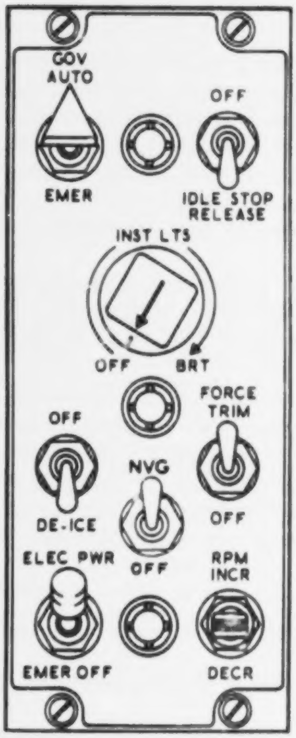

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Figure 2-10. Gunner miscellaneous control panel

(2) *Governor Switches.* The pilot or gunner GOV switches (figures 2-9 and 2-10) AUTO position permits the overspeed governor to automatically control the engine rpm. The EMER position permits the pilot and gunner to manually control the engine rpm. The governor circuit is powered by the 28 Vdc essential bus and protected by the GOV CONT circuit breaker.

2-22. Engine Oil Supply System.

a. *Description.* The engine oil system is a dry sump, pressure type, and completely automatic. The oil tank is located in the upper pylon fairing. It will self-seal a 30 caliber projectile hole and is equipped with deaeration provisions. Oil is gravity fed from tank to engine driven oil pump which provides pressure and scavenging for the system.

b. *Cooling.* Engine oil cooling is accomplished by an oil cooler and a turbine fan. The engine and transmission oil coolers use the same fan.

c. *Switching Action.* The pilot ENG OIL BYP switch (figure 2-9) AUTO position permits the oil to automatically bypass the oil cooler when the oil tank is approximately 3.8 quarts low. The OFF position deactivates the automatic bypass feature causing the oil to pass through the oil cooler regardless of the oil tank level. The switch circuit is powered by the 28 Vdc essential bus and protected by the FUEL & OIL valve circuit breaker.

2-23. Ignition — Starter System.

The pilot ignition-starter trigger switch (figure 2-4) is depressed and held to start the engine. The switch is released when the engine starts or the time limit expires. The pilot FUEL switch (figure 2-9) must be in the FUEL position and the pilot ignition keylock switch (figure 2-4) in the ON position to complete the ignition circuit. The circuits are powered by the 28 Vdc essential bus and protected by the STARTER RELAY and IGN SYS IGN SOL circuit breakers.

2-24. Governor RPM Switches.

The pilot GOV RPM switch (figure 2-4) and the gunner RPM switch (figure 2-10) INCR position permits the regulated power turbine speed to increase to 6700 ± 50 rpm. The DECR position permits the speed to decrease to 6000 ± 50 rpm. The switch is released when the desired rpm is obtained. The circuit is powered by the 28 Vdc essential bus and protected by the GOV CONT circuit breaker.

2-25. Droop Compensator.

A droop compensator maintains engine rpm (N2) as power demand is increased by the pilot. The compensator is a direct mechanical linkage between the collective stick and the speed selector lever on the N2 governor. No crew controls are provided or required. The compensator will hold N2 rpm to ± 40 rpm when properly rigged. Droop is defined as the speed change in engine rpm (N2) as power is increased from a no-load condition. It is an inherent characteristic designed into the governor system. Without this characteristic, instability would develop as engine output is increased, resulting in N1 speed overshooting or hunting the value necessary to satisfy the new power condition. Design droop of the engine governor system is as much as 300 to 400 rpm (flat pitch to full power). If N2 power were allowed to droop, other than momentarily, the reduction in rotor speed could become critical.

2-26. Engine Instruments and Indicators.

a. *Torquemeters.* The pilot and gunner torquemeters (figures 2-6 and 2-7) displays the pounds per square inch (psi) of the torque imposed upon the engine output shaft. Each torquemeter is powered by a separate transmitter. The circuit is powered by the 26 Vac system and protected by the TORQUE PRESSURE IND circuit breaker.

b. *Turbine Gas Temperature (TGT) Indicators.* The pilot and gunner indicators (figures 2-6 and 2-7) display the celsius degrees of the air in the turbine inlet area. The indicators do not require any connections to the helicopter electrical system.

c. *Dual Tachometers.* The pilot and gunner tachometers (figures 2-6 and 2-7) display the rpm of the engine and main rotor. The tachometer outer scale is marked ENGINE and the inner scale is marked ROTOR. The ENGINE and ROTOR needles are synchronized during normal helicopter operation. The tachometers do not require any connections to the helicopter electrical system.

d. *Gas Producer Tachometers.* The pilot and gunner tachometers (figures 2-6 and 2-7) display the rpm of the gas producer turbine speed in percent. The tachometers do not require any connections to the helicopter electrical system.

e. *Oil Temperature Indicator.* The pilot indicator (figure 2-6) displays the celsius degrees of the engine oil at the engine oil inlet. The circuit is powered by the 28 Vdc essential bus and protected by the TEMP IND ENG & XMSN circuit breaker.

f. Oil Pressure Indicator. The pilot indicator (figure 2-6) displays the psi pressure of the engine oil at the pressure side of the oil pump. The circuit is powered by the 26 Vac system and protected by the ENG OIL PRESSURE IND circuit breaker.

g. Oil Pressure Caution Lights. The pilot and gunner ENGINE OIL PRESS caution lights (figure 2-18) will illuminate when the engine oil pressure is below safe limits.

h. Oil Bypass Caution Light. The pilot ENGINE OIL BYPASS caution light (figure 2-18) will illuminate when the oil tank level is approximately 3.8 quarts low. The engine oil will bypass the oil cooler when the light illuminates if the pilot ENG OIL BYP switch (figure 2-9) is in the AUTO position. The oil will not bypass the oil cooler if the switch is in the OFF position.

i. Oil Chip Detector.

(1) *Chip Detector Caution Lights.* The pilot and gunner CHIP DETECTOR caution lights (figure 2-18) will illuminate when sufficient metal clips are detected in the engine, 42° gearbox, 90° gearbox, or the transmission oil. The chip detector panel is used to identify which unit is contaminated.

(2) *Chip Detector Panel.* The pilot CHIP DET panel (figure 2-11) is used to identify the contaminated component. When the pilot and gunner CHIP DETECTOR caution light illuminates, pressing the CHIP DET panel will cause the word ENG, 42°, 90°, or XMSN to illuminate. This illumination identifies the contaminated unit. The PRESS TEST switch is used to check the CHIP DET panel lights. The CHIP DET panel receives electrical power from the CHIP DETECTOR caution lights.

j. Fuel Pump Caution Lights. The pilot and gunner ENG FUEL PUMP caution lights (figure 2-18) will illuminate when either element of the engine driven fuel pump fails.

k. Governor Caution Lights. The pilot and gunner GOV EMER caution lights (figure 2-18) will illuminate when the pilot or gunner GOV switch (figures 2-9 and 2-10) is in the EMER position.

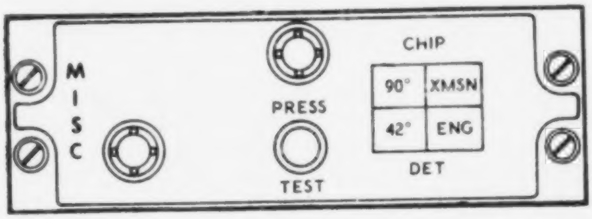

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Figure 2-11 Pilot miscellaneous control panel

Section IV. HELICOPTER FUEL SYSTEM

2-27. Fuel Supply System.

The helicopter is equipped with a crashworthy fuel system. The system is designed with the potential of containing fuel during a severe, but survivable, crash impact to reduce the possibility of fire. The system has a 50 caliber ballistic protection level.

2-28. Controls and Indicators.

a. Fuel Switch. The pilot FUEL switch (figure 2-9) FUEL position energizes the forward and aft **boost pumps, opens the fuel shutoff valve, and completes the ignition circuit. The aft boost pump circuit is powered by the 28 Vdc non-essential bus. The other circuits are powered by the 28 Vdc essential bus. The circuits are protected by the STARTER RELAY, IGN SYS IGN SOL, FUEL & OIL VALVE, FUEL BOOST FWD, and FUEL BOOST AFT circuit breakers.**

b. Fuel Quantity Indicator. The pilot indicator (figure 2-4) displays the pounds of fuel in the fuel cells. The circuit is powered by the 115 Vac system and protected by the FUEL QTY IND circuit breaker.

c. Fuel Quantity Indicator Test Switch. The pilot fuel gauge test switch (figure 2-4) is used to test the fuel quantity indicator operation. Pressing the switch will cause the indicator pointer to move from the actual reading to a lesser reading. Releasing the switch will cause the pointer to return to the actual reading. The circuit is powered by the 115 Vac system and protected by the FUEL QTY IND circuit breaker.

d. Low Quantity Caution Lights. The pilot and gunner 10% FUEL caution lights (figure 2-18) will illuminate when there is approximately 10% of the total fuel remaining.

e. Fuel Pressure Indicator. The pilot indicator (figure 2-4) displays the psi pressure of the fuel being delivered by boost pumps from the fuel cells to the engine. The circuit is powered by the 26 Vac system and protected by the FUEL PRESSURE IND circuit breaker.

f. Low Fuel Pressure Caution Lights. The pilot FWD FUEL BOOST and AFT FUEL BOOST caution lights (figure 2-18) will illuminate when the boost pumps in the forward/aft fuel cell fail or FUEL switch is off.

g. Fuel Filter Caution Lights. The pilot and gunner FUEL FILTER caution lights (figure 2-18) will illuminate when the filter in the fuel supply line becomes partially obstructed.

Section V. FLIGHT CONTROLS

2-29. Description.

The flight control system is a positive mechanical type, actuated by conventional helicopter controls. Complete controls are provided for both pilot and gunner. The gunner controls are slaved to the pilot controls. The system includes a cyclic system, a collective control system, a tail rotor system, a force trim system, and a stability and control augmentation system (SCAS).

2-30. Cyclic Control System.

The system is operated by the cyclic stick (figures 2-4 and 2-5) movement. Moving the stick in any direction will produce a corresponding movement of the helicopter which is the result of a change in the plane of rotation of the main rotor. The stick fore and aft movement also changes the synchronized elevator (figure 2-1) attitude to assist controllability and cg range.

2-31. Collective Control System.

The system is operated by the collective stick (figures 2-4 and 2-7). Moving the stick up or down will determine the angle of attack and lift developed by the main rotor resulting in the ascent or descent of the helicopter.

2-32. Tail Rotor Control System.

The system is operated by the pedals (figure 2-4 and 2-5). Pushing a pedal will alter the pitch of

the tail rotor resulting in directional control. Also, the pedals may be used to pivot the helicopter on its own vertical axis. A pedal adjuster (figure 2-5) is provided to adjust the pedal distance for individual comfort. Heel rests are provided for the gunner to prevent inadvertent pedal operation.

2-33. Force Trim System.

The system incorporates a magnetic brake and gradient in the cyclic and pedal control systems to provide artificial feel into the system. Also, it provides a means to trim the controls. Placing the FORCE TRIM switches (figures 2-9 and 2-10) in the TRIM position will induce artificial feel into the systems. Depressing the cyclic stick force trim switch (figures 2-4 and 2-5) will cause the magnetic brake and force gradient to be repositioned to correspond to the positions of the cyclic stick and pedals thus providing trim. The system is powered by the 28 Vdc essential bus and protected by the FORCE TRIM circuit breaker.

2-34. Stability and Control Augmentation System (SCAS).

a. Description. The SCAS is a three-axis, limited authority rate reference augmentation system. The SCAS provides a smoother flying weapon platform and cancels undesired motion of the helicopter during flight. This is accomplished by inducing an electrical pilot input into the flight control system to augment the pilot mechanical input.

CAUTION

Should an engagement be attempted during this warmup period, the actuator will make an abrupt input to the flight controls at the moment of engagement.

b. Control Panel. The SCAS control panel (figure 2-12) contains a POWER switch for applying 28 Vdc (essential bus) and 115 Vac operating voltages to the system. The circuits are protected by the SAS PWR dc and SAS PWR ac circuit breakers. It also contains three magnetic latching channel engage switches which energize electric solenoid valves controlling hydraulic pressure to the system. The panel has three NO-GO lights; one associated with each PITCH, ROLL, and YAW channel engage switch. These lights are illuminated during the warmup to indicate the presence of current in each associated channel actuators. When engagement is made, the NO-GO lights are locked out of the circuit and do not operate as malfunction indicators. Disengaging a channel, however, restores the associated light to operation. The NO-GO lights have a built-in press-to-test feature for insuring that the indicator is operational, but this feature works only prior to channel engagement.

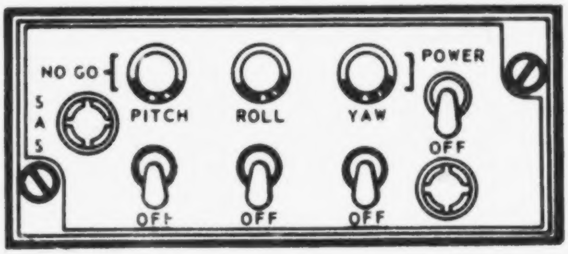


Figure 2-12. Pilot SCAS control panel

c. SCAS Release Switch. The cyclic grip mounted switch (figures 2-4 and 2-5) is used to disengage the pitch, roll, and yaw channels simultaneously. The channels are re-engaged by the PITCH, ROLL, and YAW switches on the SCAS control panel.

Section VI. HYDRAULIC SYSTEMS

2-35. Description.

The hydraulic system is a dual system (No. 1 and No. 2 system) used to minimize the force required by the pilot to move the cyclic, collective, and foot pedal controls. The No. 1 and No. 2 systems are installed to provide maximum separation to reduce the probability of a single projectile incapacitating both systems.

2-36. Hydraulic System No. 1.

The No. 1 system provides hydraulic power to the cyclic controls, collective controls, foot pedal controls, SCAS yaw controls and charges emergency collective control system. The No. 1 system is located on the left side of the helicopter.

2-37. Hydraulic System No. 2.

The No. 2 system provides hydraulic power to the cyclic controls, collective controls, turret system, SCAS pitch and roll controls and articulated wing pylons. The No. 2 system is located on the right side of the helicopter.

2-38. Test Switch.

The pilot HYD TEST switch (figure 2-9) is used to test the No. 1 and No. 2 hydraulic systems. Holding the switch in the SYS 1 position will cause the No. 1 system to be the only system supplying hydraulic pressure. Similar action occurs when the switch is held in the SYS 2 position.

2-39. Reservoir Fluid Sight Glasses.

The No. 1 and No. 2 reservoirs are provided with a fluid sight glass. Both sight glasses can only be seen from the left hydraulic compartment door.

2-40. Filter Indicators.

The No. 1 and No. 2 pressure and return filters are provided with a differential pressure indicator. The red indicator pops out when the filter needs changing or during cold weather operation.

2-41. Low Pressure Caution Lights.

The pilot and gunner HYD PRESS #1 and HYD PRESS #2 caution lights (figure 2-18) will illuminate when the hydraulic pressure is below safe limits.

2-42. Electrical Circuit.

The hydraulic electrical circuit is powered by the 28 Vdc essential bus and protected by the HYD CONT circuit breaker.

2-43. Emergency Hydraulic Control System.

a. Emergency Collective Control System. The system provides limited collective control operations if the No. 1 and No. 2 systems fail. The pilot and gunner EMER COLL HYD switches (figures 2-6 and 2-7) control the emergency system. The switch is in the OFF position during normal operations. With the switch in the OFF position when the No. 1 and No. 2 systems fail will cause sufficient fluid to be retained in an accumulator for an emergency landing. Placing the switch in the ON position will allow four full strokes of the collective stick: A stroke is a maximum movement in one direction. The accumulator has a pressure gage which displays the psi of its compressed nitrogen.

b. Emergency Cyclic Control System. The system provides limited cyclic control operations if the No. 1 and No. 2 systems fail. The system is automatic, using spring pressure in a small accumulator, and has no external controls.

2-44. Armament Hydraulic System.

a. Turret System. The system is powered by the No. 2 system and enables the turret to be traversed through varied positions in elevation and azimuth. The system is controlled by the turret controls. The system electrical circuit is powered by the 28 Vdc essential and nonessential busses and the 115 Vac system. The circuit is protected by the dc HYD CONT, dc TURRET POWER, ac HSS PWR, and ac WEAPON SIGHT circuit breakers.

b. TOW Missile System. The system is powered by the No. 2 system and is used to position the outboard articulated wing pylons during TOW missile operations. The system is controlled by the TOW missile controls. The system electrical circuit is powered by the 28 Vdc essential bus and the 115 Vac system. The circuit is protected by the dc HYD CONT, ac TOW PWR, and ac SECU PWR circuit breakers.

Section VII. POWER TRAIN SYSTEM

2-45. Transmission.

The transmission transfers engine power to the main rotor through the mast assembly and to the tail rotor through a series of driveshafts and gearboxes. The transmission has a self-contained pressure oil system. The oil is cooled by an oil cooler and turbine fan. The transmission and engine oil coolers use the same fan. The oil system has an automatic bypass system which causes the oil to bypass the cooler when a flow differential exists between pump and cooler output. Two oil level sight glasses, an oil filler cap, and a magnetic chip detector are provided.

2-46. Gearboxes.

a. *Intermediate Gearbox — 42 Degree.* The gearbox is located at the base of the vertical fin. It provides a 42 degree change of direction of the tail rotor driveshaft. The gearbox has a self-contained wet sump oil system. An oil level sight glass, a filler cap, and a magnetic chip detector are provided.

b. *Tail Rotor Gearbox — 90 Degree.* The gearbox is located near the top of the vertical fin. It provides a 90 degree change of direction of the tail rotor driveshaft. The gearbox has a self-contained wet sump oil system. An oil level sight glass, a filler cap, and a magnetic chip detector are provided.

2-47. Driveshafts.

a. *Main Driveshaft.* The main driveshaft connects the engine output shaft to the transmission input drive quill.

b. *Tail Rotor Driveshaft.* The tail rotor driveshaft consists of five driveshaft and three hanger bearing assemblies. The assemblies and the 42 and 90 degree gearboxes connect the transmission tail rotor drive quill to the tail rotor.

2-48. Indicators and Caution Lights.

a. *Transmission Oil Pressure Indicator.* The pilot indicator (figure 2-6) displays the psi of oil pressure of the transmission oil system. The electrical circuit is powered by the 26 Vac system and protected by the XMSN OIL PRESSURE IND circuit breaker.

b. *Transmission Oil Low Pressure Caution Lights.* The pilot and gunner XMSN OIL PRESS caution lights (figure 2-18) will illuminate when the transmission oil pressure drops below safe limits.

c. *Transmission Oil Temperature Indicator.* The pilot indicator (figure 2-6) displays the celsius temperature of the transmission oil. The electrical circuit is powered by the 28 Vdc essential bus and protected by the TEMP IND ENG & XMSN circuit breaker.

d. *Transmission Oil Hot Caution Lights.* The pilot and gunner XMSN OIL HOT caution lights (figure 2-18) will illuminate when the transmission oil temperature exceeds the safe limits.

e. *Transmission Oil Cooler Bypass Caution Light.* The pilot XMSN OIL BYPASS caution light (figure 2-18) will illuminate when the automatic oil bypass system is activated causing the oil to bypass the oil cooler.

f. *Transmission and Gearboxes Chip Detector.*

(1) *Chip Detector Caution Lights.* The pilot and gunner CHIP DETECTOR caution lights (figure 2-18) will illuminate when sufficient metal chips are detected in the engine, 42° gearbox, 90° gearbox, on the transmission oil. The chip detector panel is used to identify which unit is contaminated.

(2) *Chip Detector Panel.* The pilot CHIP DET panel (figure 2-11) is used to identify the contaminated component. When the pilot and gunner CHIP DETECTOR caution light illuminates, pressing the CHIP DET panel will cause the word ENG, 42°, 90° or XMSN to illuminate. This illumination identifies the contaminated unit. The PRESS TEST switch is used to check the CHIP DET panel lights. The panel receives electrical power from the caution panel light circuit breaker.

Section VIII. MAIN AND TAIL ROTORS

2-49. Main Rotor.

a. *Description.*

(1) **B540** The main rotor blades are metal, bonded assemblies. Each blade is attached in the hub with a retaining bolt assembly and is held in alignment by adjustable drag braces.

(2) **K747** The main rotor blades are glass fiber epoxy resin bonded assemblies with a rubber erosion guard. The skin is basket weave which will not be as smooth as a metal blade. Each blade is attached in the hub with a retaining bolt assembly and is held in alignment by adjustable drag braces.

(3) The main rotor is driven by the mast which is connected to the transmission. The rotor rpm is governed by the engine rpm during powered flight. The rotor tip path plane is controlled by the cyclic stick. The rotor pitch is controlled by the collective stick.

b. *RPM Indicators.* The pilot and gunner indicators are part of the dual tachometers (figures 2-6 and 2-7). The tachometer inner scale displays the rotor rpm. The inner scale pointer is marked with an R.

2-50. Tail Rotor.

The tail rotor is driven by the 90 degree gearbox which is connected to the transmission by the tail rotor driveshaft assemblies and the 42 degree gearbox. The rotor rpm is governed by the transmission rpm. The rotor blade pitch is controlled by the foot pedals.

Section IX. UTILITY SYSTEM

2-51. Pitot Tube Heater.

The pitot tube (figure 2-1) is equipped with an electrical heater. The pilot PITOT HEAT switch (figure 2-6) HEAT position activates the heater in the tube and prevents ice from accumulating in the pitot tube. The OFF position deactivates the heater. The electrical circuit is powered by the 28 Vdc nonessential bus and protected by the PITOT HEAT circuit breaker.

2-52. Canopy Defrosting, Deicing and Rain Removal Systems.

These systems are considered to be part of the environmental control system. See section X of this chapter.

Section X. HEATING, VENTILATION, COOLING, ENVIRONMENTAL CONTROL UNIT

2-53. Environmental Control Unit (ECU).

a. *ECU Functions.*

(1) Heats/cools the crew compartment.

(2) Removes moisture from the air supplied to the crew compartment.

(3) Defrosts, defogs, and deices the canopy.

(4) Removes rain from the canopy.

(5) Provides ambient air ventilation to the crew compartment.

b. *ECU Power Source.* The ECU is electrically controlled and engine bleed air powered. The circuit is powered by the 28 Vdc nonessential bus and protected by the ECU CONT circuit breaker.

c. *ECU Controls.*

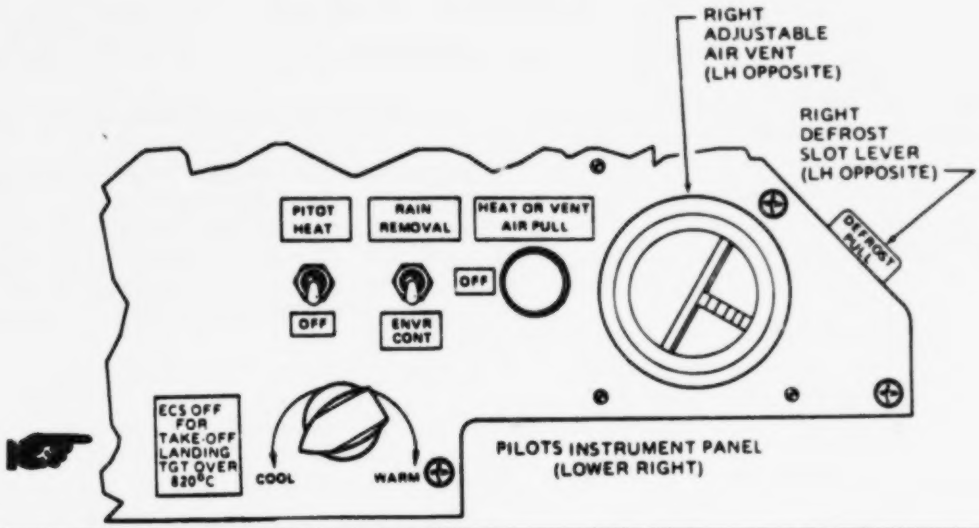
NOTE

Under certain conditions a plume may be observed at the air vents in the crew compartment. The plume may appear to be smoke, but is actually condensation.

(1) The pilot ECU controls and their functions are shown on figure 2-13.

(2) The pilot and gunner controls the volume and direction of the air entering the crew compartment using the adjustable air vents in their instrument panels.

(3) The pilot and gunner controls the volume of air entering their seat cushions using the valve at the top of each seat.


RIGHT
ADJUSTABLE
AIR VENT
(LH OPPOSITE)
RIGHT
DEFROST
SLOT LEVER
(LH OPPOSITE)
PITOT HEAT
RAIN REMOVAL
HEAT OR VENT AIR PULL
OFF
DEFROST PULL
OFF
ENVR CONT
ECS OFF FOR TAKE-OFF LANDING TGT OVER 820°C
COOL
WARM
PILOTS INSTRUMENT PANEL
(LOWER RIGHT)

SWITCH/CONTROL	POSITION	FUNCTION
COOL/WARM	COOL to WARM	Controls temperature between 35 F (2 C) and 180 F (82 C) in the crew compartment when the RAIN REMOVAL/ENVR CONT switch is in the ENVR CONT position.
RAIN REMOVAL/ ENVR CONT	RAIN REMOVAL	Removes rain from canopy. Only ambient air ventilation enters the crew compartment. May be used to defrost, defog, or deice the forward area of the canopy. CAUTION A dry canopy will melt if rain removal system is operated for a lengthy period.
	ENVR CONT	Heats or cools the crew compartment.
	OFF	Ambient air ventilation enters the crew compartment.
HEAT OR VENT AIR PULL	OUT	Directs maximum air to crew compartment.
	IN	Air flow to crew compartment is shut off, except to pilot seat cushion.
Air Vent	Open/Closed	Controls the volume/direction of air to the crew compartment.
Defrost Slot Lever	Aft (Open)/ forward (closed)	Controls the volume of air directed to the inner surfaces of the canopy for defogging, defrosting, and deicing.

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Figure 2-13. ECU controls

Section XI. ELECTRICAL POWER SUPPLY AND DISTRIBUTION SYSTEM

2-54. DC and AC Power Distribution.

Figure 2-14 depicts the general schematic of the dc and ac power distribution system. The dc power is supplied by the battery, starter-generator, or the external power receptacle. The 115 Vac power is supplied by the main or standby inverters. The 28 Vac power is supplied by the 28 Vac transformer.

2-55. Battery.

The battery (figure 2-1) supplies 24 Vdc power to the power distribution system when the starter-generator and the external power receptacle are not in operation.

2-56. Starter-Generator.

The starter-generator (rated 300 amps) is mounted on and driven by the engine. The starter-generator supplies 28 Vdc power to the power distribution system and recharges the battery. Avoid continuous operation above 200 amps to prevent heat damage to starter-generator.

2-57. External Power Receptacle.

The external power receptacle (figure 2-1) transmits the ground power unit 28 Vdc power to the power distribution system. A 7.5 KW GPU is recommended for external starts.

2-58. Gunner Electrical Power Control.

The gunner ELEC PWR — EMER OFF switch (figure 2-10) in the ELEC PWR position permits the pilot to control the electrical system. The switch in the EMER OFF position deactivates the electrical system and negates the pilot controls.

2-59. Pilot DC Power Indicators and Controls.

a. Battery Switch. The pilot BAT switch (figure 2-15) ON position permits the battery to supply 24 Vdc to the power distribution system or permits the battery to be charged by the starter-generator. The OFF position isolates the battery from the system.

b. Generator Switch. The pilot GEN switch (figure 2-15) ON position permits the starter-generator to supply 28 Vdc power to the power distribution system and to charge the battery. The RESET position will reset the starter-generator. When the switch is released, it will return to OFF. The OFF position isolates the generator from the system. The circuit is protected by the GEN BUS RESET and GEN FIELD circuit breaker.

c. Nonessential Bus Switch. The pilot NON-ESS switch (figure 2-15) NORMAL position permits the nonessential bus to receive 28 Vdc power from the starter-generator. The MANUAL position permits the nonessential bus to receive dc power from the battery.

d. DC Circuit Breaker Panel. The pilot dc circuit breakers (figure 2-16) in the "pushed-in" position provide circuit protection for the 28 Vdc operated equipment. The breakers in the "pulled-out" position deactivate the circuit. The breakers will "pop out" automatically in the event of a circuit overload. Each breaker is labeled for the particular circuit it protects. Each applicable breaker is listed in the paragraph describing the equipment it protects.

NOTE

Some armament circuit breakers may be toggle type.

e. Volt-Ammeter Indicator. The pilot indicator (figure 2-4) simultaneously displays the voltage and amperage of dc power being supplied to the power distribution system. The indicator right scale displays the volts. The left scale displays the amps. The circuit is powered by the 28 Vdc essential bus and protected by the DC VOLTMETER circuit breaker.

f. Generator Caution Lights. The pilot and gunner DC GENERATOR caution lights (figure 2-18) will illuminate when the dc generator fails.

g. External Power Receptacle Caution Light. The pilot EXTERNAL POWER caution light (figure 2-18) will illuminate when the external power receptacle door is open.

2-60. AC Power Indicators and Controls.

a. Inverter Switch. The pilot INV switch (figure 2-15) MAIN position selects the main

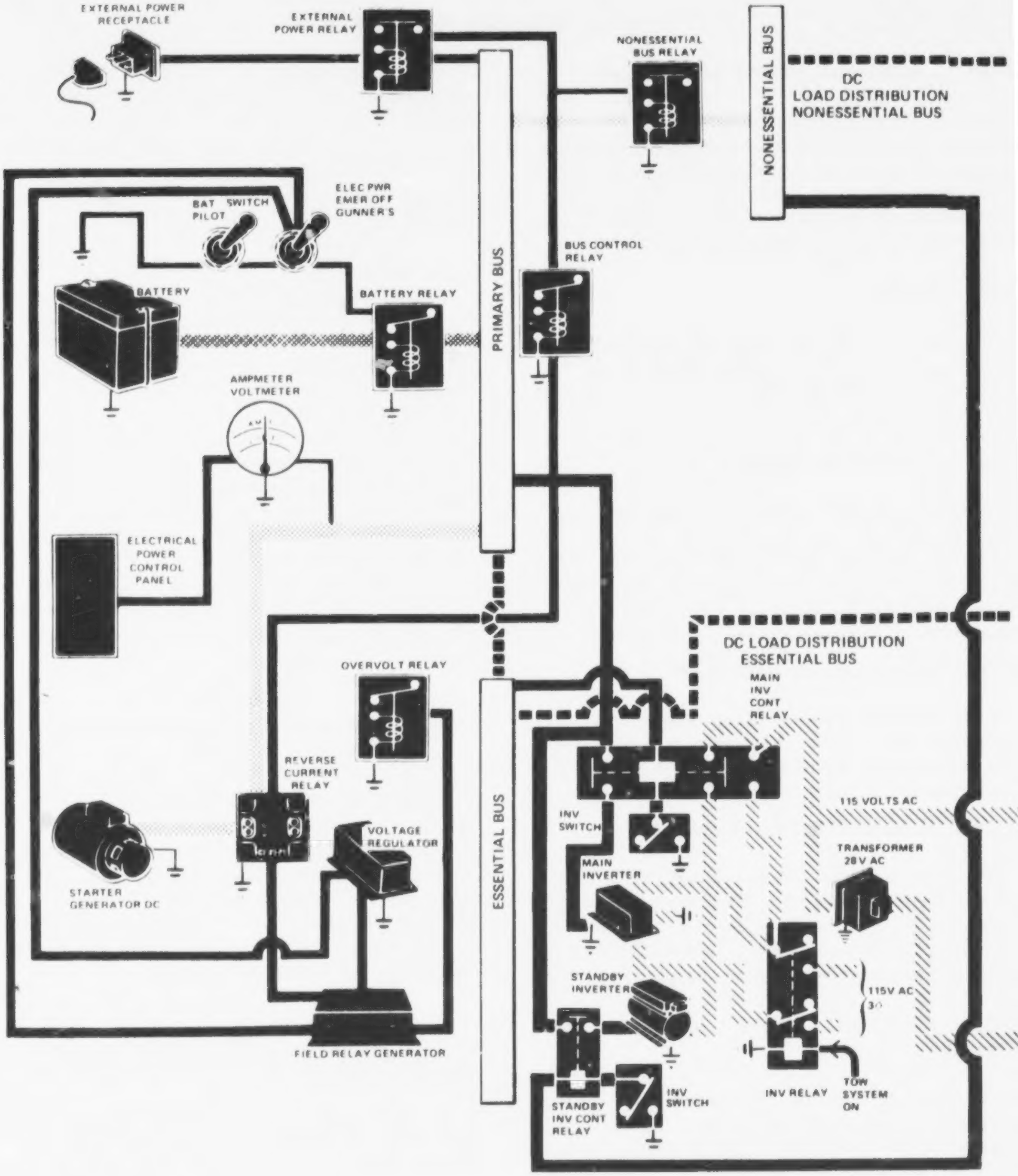
EXTERNAL POWER RECEPTACLE
EXTERNAL POWER RELAY
NONESSENTIAL BUS RELAY
NONESSENTIAL BUS
DC LOAD DISTRIBUTION NONESSENTIAL BUS
BAT SWITCH PILOT
ELEC PWR EMER OFF GUNNER'S
BUS CONTROL RELAY
BATTERY
BATTERY RELAY
PRIMARY BUS
AMPMETER VOLTMETER
ELECTRICAL POWER CONTROL PANEL
DC LOAD DISTRIBUTION ESSENTIAL BUS
MAIN INV CONT RELAY
OVERVOLT RELAY
REVERSE CURRENT RELAY
VOLTAGE REGULATOR
STARTER GENERATOR DC
ESSENTIAL BUS
INV SWITCH
115 VOLTS AC
MAIN INVERTER
TRANSFORMER 28 V AC
STANDBY INVERTER
115V AC 3∅
FIELD RELAY GENERATOR
STANDBY INV CONT RELAY
INV SWITCH
INV RELAY
TOW SYSTEM ON
209475-307-1C

Figure 2-14. DC and AC power distribution (Sheet 1 of 2)

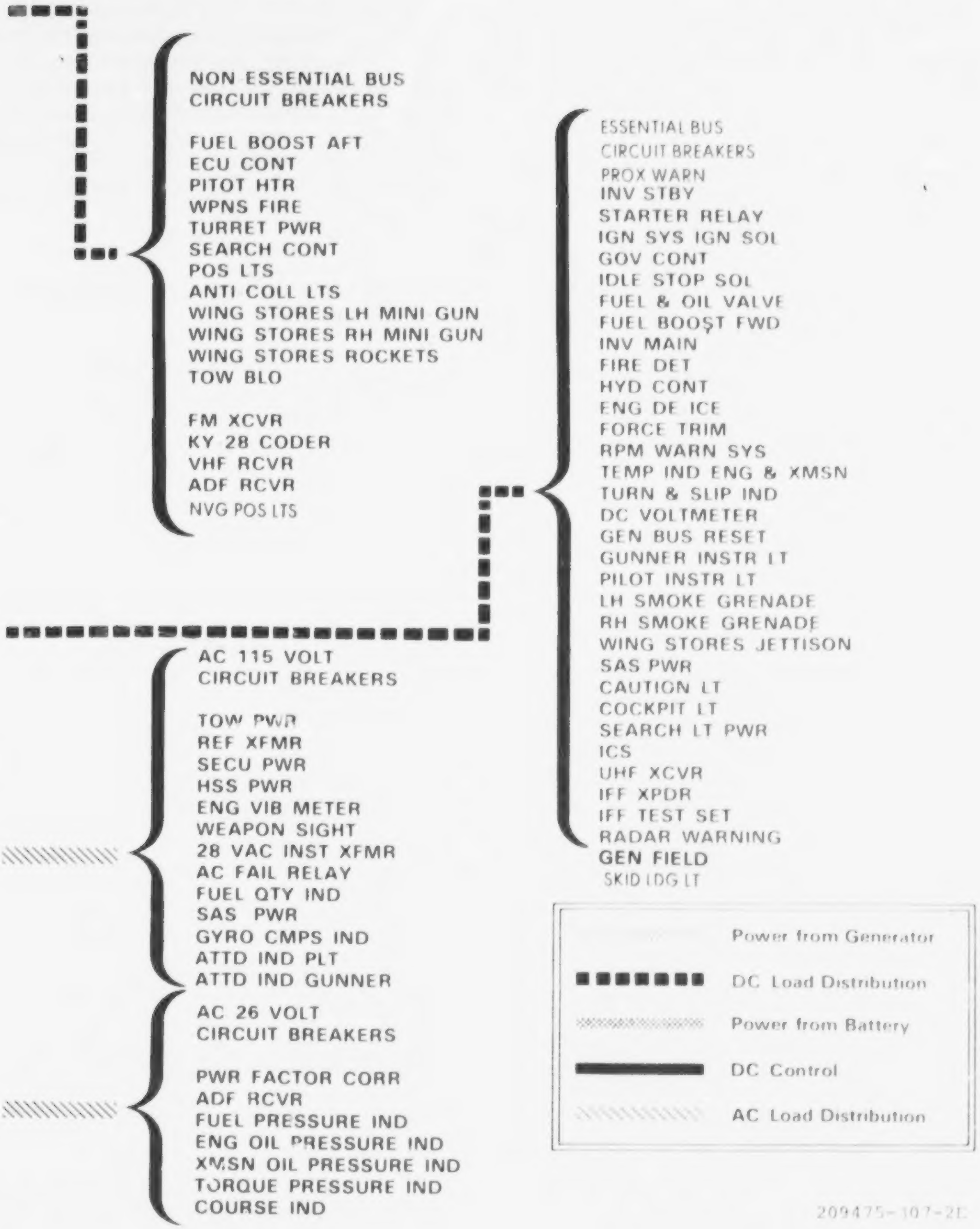
NON ESSENTIAL BUS
CIRCUIT BREAKERS
FUEL BOOST AFT
ECU CONT
PITOT HTR
WPNS FIRE
TURRET PWR
SEARCH CONT
POS LTS
ANTI COLL LTS
WING STORES LH MINI GUN
WING STORES RH MINI GUN
WING STORES ROCKETS
TOW BLO
FM XCVR
KY 28 CODER
VHF RCVR
ADF RCVR
NVG POS LTS
ESSENTIAL BUS
CIRCUIT BREAKERS
PROX WARN
INV STBY
STARTER RELAY
IGN SYS IGN SOL
GOV CONT
IDLE STOP SOL
FUEL & OIL VALVE
FUEL BOOST FWD
INV MAIN
FIRE DET
HYD CONT
ENG DE ICE
FORCE TRIM
RPM WARN SYS
TEMP IND ENG & XMSN
TURN & SLIP IND
DC VOLTMETER
GEN BUS RESET
GUNNER INSTR LT
PILOT INSTR LT
LH SMOKE GRENADE
RH SMOKE GRENADE
WING STORES JETTISON
SAS PWR
CAUTION LT
COCKPIT LT
SEARCH LT PWR
ICS
UHF XCVR
IFF XPDR
IFF TEST SET
RADAR WARNING
GEN FIELD
SKID LDG LT
AC 115 VOLT
CIRCUIT BREAKERS
TOW PWR
REF XFMR
SECU PWR
HSS PWR
ENG VIB METER
WEAPON SIGHT
28 VAC INST XFMR
AC FAIL RELAY
FUEL QTY IND
SAS PWR
GYRO CMPS IND
ATTD IND PLT
ATTD IND GUNNER
AC 26 VOLT
CIRCUIT BREAKERS
PWR FACTOR CORR
ADF RCVR
FUEL PRESSURE IND
ENG OIL PRESSURE IND
XMSN OIL PRESSURE IND
TORQUE PRESSURE IND
COURSE IND
Power from Generator
DC Load Distribution
Power from Battery
DC Control
AC Load Distribution
209475-107-2E

Figure 2-14. DC and AC power distribution (Sheet 2 of 2)

inverter. It is powered by the 28 Vdc essential bus and protected by the INV MAIN circuit breaker. The STBY position selects the standby inverter. It is powered by the 28 Vdc essential bus and protected by the INV STBY circuit breaker. The OFF position deactivates the MAIN and STANDBY inverter circuits.

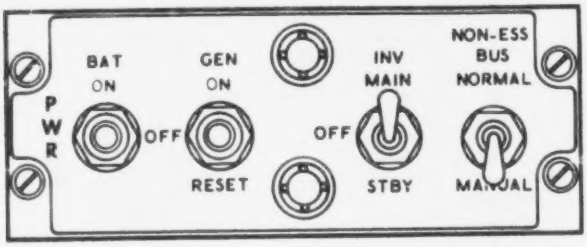

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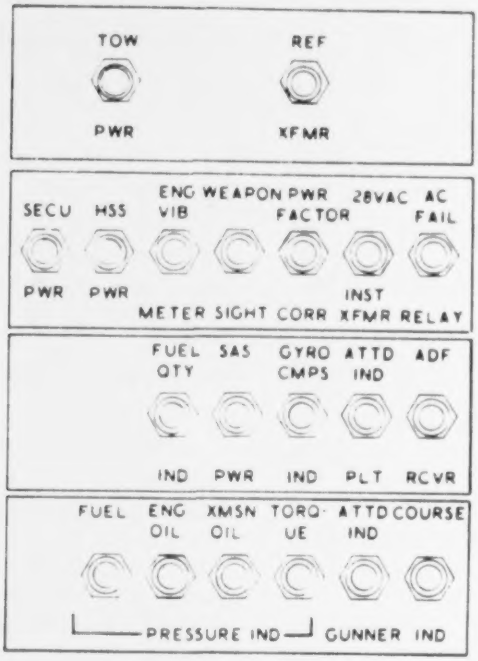
Figure 2-15. Pilot electrical power panel

b. AC Circuit Breaker Panel. The pilot ac circuit breakers (figure 2-16) in the "pushed-in" position provide circuit protection for the 28 Vac and 115 Vac operated equipment. The breakers in the "pulled-out" position deactivate the circuit. The breakers will "pop out" automatically in the event of a circuit overload. Each breaker is labeled for the particular circuit it protects. Each applicable breaker is listed in the paragraph describing the equipment it protects.

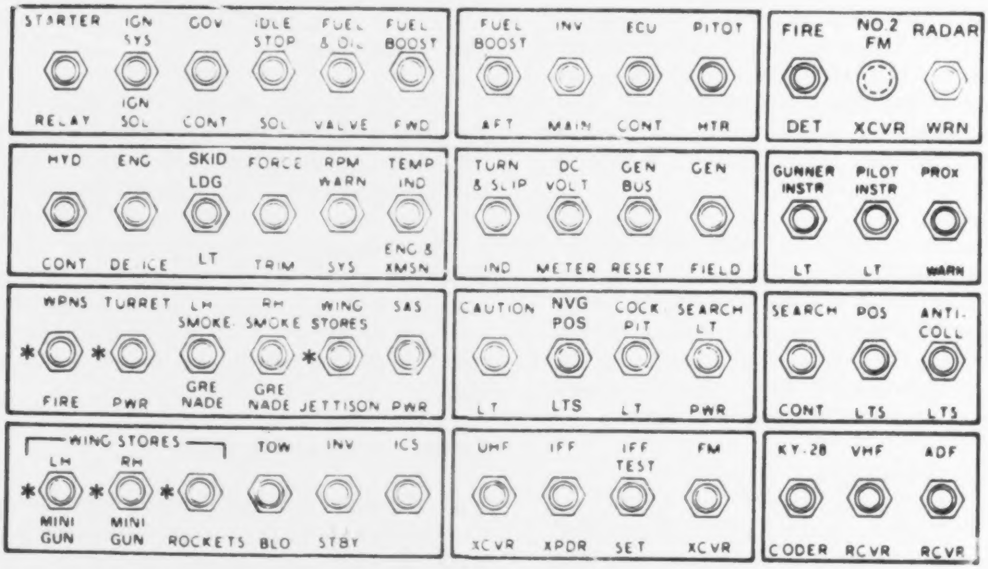
NOTE

Some armament circuit breakers may be toggle type.

c. AC Failure Caution Light. The pilot INST INVERTER caution light (figure 2-18) will illuminate when the inverter in use fails or when the INV switch is in the OFF position.


TOW PWR
REF XFMR
SECU PWR
HSS PWR
ENG VIB METER
WEAPON SIGHT
PWR FACTOR CORR
28VAC INST XFMR
AC FAIL RELAY
FUEL QTY IND
SAS PWR
GYRO CMPS IND
ATTD IND PLT
ADF RCVR
FUEL
ENG OIL
XMSN OIL
TORQUE
PRESSURE IND
ATTD IND
COURSE
GUNNER IND

AC CIRCUIT BREAKER PANEL


STARTER RELAY
IGN SYS IGN SOL
GOV CONT
IDLE STOP SOL
FUEL & OIL VALVE
FUEL BOOST FWD
FUEL BOOST AFT
INV MAIN
ECU CONT
PITOT HTR
FIRE DET
NO.2 FM XCVR
RADAR WRN
HYD CONT
ENG DE ICE
SKID LDG LT
FORCE TRIM
RPM WARN SYS
TEMP IND ENG & XMSN
TURN & SLIP IND
DC VOLT METER
GEN BUS RESET
GEN FIELD
GUNNER INSTR LT
PILOT INSTR LT
PROX WARN
*WPNS FIRE
*TURRET PWR
LH SMOKE GRENADE
RH SMOKE GRENADE
*WING STORES JETTISON
SAS PWR
CAUTION LT
NVG POS LTS
COCKPIT LT
SEARCH LT PWR
SEARCH CONT
POS LTS
ANTI-COLL LTS
WING STORES
*LH MINI GUN
*RH MINI GUN
*ROCKETS
TOW BLO
INV STBY
ICS
UHF XCVR
IFF XPDR
IFF TEST SET
FM XCVR
KY-28 CODER
VHF RCVR
ADF RCVR

DC CIRCUIT BREAKER PANEL

NOTE

Armament circuit breakers indicated by asterisk may be toggle or push-pull type.

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Figure 2-16. Circuit breaker panels

Section XII. LIGHTING

2-61. Position Lights

a. Standard Position Lights.

(1) General. The position lights consist of the right wing green light, left wing red light, and the two tailboom white lights (figure 2-1). The lights are powered by the 28 Vdc nonessential bus and protected by the POS LTS circuit breaker.

(2) Operation. The pilot POSITION LTS (FLASH) OFF/STEADY switch (figure 2-17) FLASH position flash the four lights off and on. The STEADY position illuminates the four lights continuous. The OFF position deactivates the four lights. The pilot POSITION LTS (BRT/DIM) switch (figure 2-17) controls the four lights brightness.

b. NVG Position Lights.

(1) General. A covert lighting system, consisting of five infrared NVG position lights, has been provided for use during multi-ship night vision goggle (NVG) operations. The lights are mounted adjacent to the standard position lights and at the top of the vertical fin (figure 2-1). The lights are powered by the dc nonessential bus and protected by the NVG POS LTS circuit breaker (figure 2-16).

(2) Operation. The NVG POS LTS (OFF/five position) rotary switch (figure 2-4) controls the operatoin of the NVG position lights. Position 1 activates the lights at minimum intensity. The intensity may be increased incrementally by rotating the switch toward BRT. The OFF position deactivates the five NVG position lights.

2-62. Anti-Collision Light.

a. General. The anti-collision light (figure 2-1) is powered by the 28 Vdc nonessential bus and protected by the ANTI-COLL LTS circuit breaker.

b. Operation. The pilot ANTI-COLL LT switch (figure 2-17) ON position illuminates the anti-collision light. The OFF position deactivates the light.

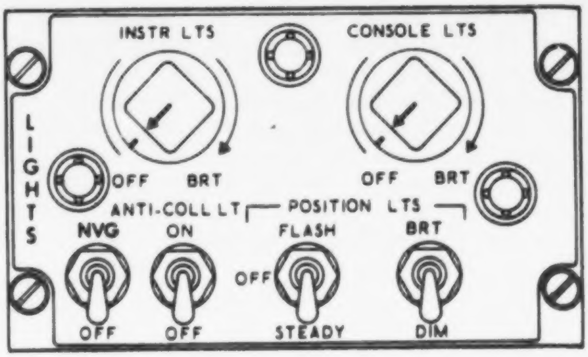


Figure 2-17. Pilot lights control panel

2-63. Searchlight.

a. General. The searchlight (figure 2-1) is powered by the 28 Vdc essential bus and protected by the SEARCH LT PWR circuit breaker. The searchlight control is 28 Vdc nonessential bus powered and protected by the SEARCH CONT circuit breaker.

b. Operation.

(1) Searchlight Switch. The pilot SL switch (figure 2-4) ON position illuminates the light. The OFF position deactivates the light. The STOW position retracts the light into the fuselage well.

(2) Searchlight Control Switch. The pilot SEARCH CONT switch (figure 2-4) EXT position extends the light from the fuselage well and moves it forward. RETR position moves the light aft. The L/R position moves the light left and right.

2-63A. Skid Landing Light.

a. General. A fixed landing light is installed on the left side of the aircraft attached to the forward landing gear crosstube (figure 2-1). This light provides a white light capability for use during night operation without NVG. The landing light is powered by the dc essential bus and protected by the SKID LDG LT circuit breaker.

b. Operation. The SKID LDG LT switch (figure 2-4) ON position illuminates the light. The OFF position deactivates the light. The elevation of the landing light beam is adjustable on the ground only.

NOTE

The IR filter and 150 watt bulb may be installed on the skid landing light with the 450 watt bulb installed in the standard searchlight housing. This configuration provides a slewable white searchlight and a ground-adjustable IR light.

2-64. Cockpit Utility Lights.

a. General. The pilot (two) and the gunner (one) utility lights are powered by the 28 Vdc essential bus and protected by the COCKPIT LT circuit breaker. The lights are supplied in various configurations. All configurations have on/off and bright/dim capabilities and provide NVG compatible light. Adjustable extensions have been provided for pilot (right) and gunner utility lights. An alternate light bracket is provided for the pilot (left) utility light.

NOTE

The cockpit utility light lens selector must be placed in the "white" position in order to provide adequate illumination with the NVG filters installed.

b. Operation. The pilot gunner determines the configuration of his light and operates it accordingly. Cockpit (map) lights must be in the blue-green mode when operating in the night vision environment to prevent light blindness; and in the white mode when operating in the normal environment to provide proper visibility.

2-65. Pilot Station Lighting.

a. Pilot Instrument Panel Lighting.

(1) General. The panel is illuminated by hooded type and instrument built-in lights. The lights are powered by the 28 Vdc essential bus and protected by the PILOT INSTR LT circuit breaker.

(2) Normal Lighting Operation. The pilot INSTR LTS rheostat knob (figure 2-17) OFF position deactivates the lights. The between OFF and BRT positions controls the brightness of the instrument built-in lights. The hooded lights have no brightness control.

(3) ***Night Vision Goggle Lighting Operation.*** A two position (NVG/OFF) switch is provided (figure 2-17) to activate the night vision system. The NVG position activates the night vision feature of the system, and cockpit is lighted to be compatible with night vision goggles. The OFF position deactivates the night vision feature, and normal lighting conditions are restored. Intensity of NVG lighting is accomplished by use of CONSOLE LTS rheostat knob.

b. Pilot Consoles and Collective Stick Switchbox Lighting.

(1) *General.* The console is illuminated by edgelight panels and equipment built-in lights. The switchbox is illuminated by one hooded type light. The lights are powered by the 28 Vdc essential bus and protected by the PILOT INSTR LT circuit breaker.

(2) *Operation.* The pilot CONSOLE LTS rheostat knob (figure 2-17) OFF position deactivates the light. The between OFF and BRT positions controls the brightness of the console edge-light panels and equipment built-in lights. The switchbox hooded light has no brightness control.

2-66. Gunner Station Lighting.

a. General. The gunner instrument panel is illuminated by hooded type and instrument built-in lights. The miscellaneous control panel (figure 2-10) and the armament control panel (Chapter 4) are illuminated by edgelight panels. The magnetic compass (figure 2-5) is illuminated by one hooded type light. The lights are powered by the 28 Vdc essential bus and protected by the GUNNER INSTR LT circuit breaker.

b. Normal Lighting Operation. The gunner INSTR LTS rheostat knob (figure 2-10) OFF position deactivates the lights. The between OFF and BRT positions control the brightness of the instrument built-in lights and the edgelight panels. The hooded lights have no brightness control.

c. Night Vision Goggle Lighting Operation. A two position (NVG/OFF) switch is provided (figure 2-10) to activate the night vision system. The NVG position activates the night vision feature of the system, and the cockpit is lighted to be compatible with night vision goggles. The OFF position deactivates the night vision feature and normal lighting conditions are restored. Intensity of NVG lighting is accomplished by use of INST LTS rheostat knob.

Section XIII. FLIGHT INSTRUMENTS

2-67. Airspeed Indicators.

The pilot and gunner airspeed indicators (figures 2-6 and 2-7) display the helicopter indicated airspeed (IAS) in knots. The IAS is obtained by measuring the difference between impact air pressure from the pitot tube (figure 2-1) and the static air pressure from the static ports (figure 2-1).

NOTE

IAS below approximately 25 KIAS is inaccurate due to rotor downwash.

2-68. Pressure Altimeters.

The pilot and gunner altimeters (figures 2-6 and 2-7) display the helicopter height above sea level in feet.

2-69. Attitude Indicators.

The pilot and gunner attitude indicators (figures 2-6 and 2-7) display the helicopter pitch and roll attitudes in relation to the earth. Pitch attitude is displayed by the motion of the sphere with respect to the miniature airplane. Roll attitude is displayed by the motion of the roll pointer with respect to the fixed roll scale. The sphere can be adjusted to zero indication by the pitch trim knob. The power OFF flag is out of view when the indicator is energized. A power failure will cause the OFF flag to appear. The circuit is powered by the 115 Vac system and protected by the ATTD IND PLT and ATTD IND GUNNER circuit breakers.

2-70. Turn and Slip Indicator.

The pilot turn and slip indicator (4 MIN TURN) (figure 2-6) displays the helicotper slip condition, direction of turn and rate of turn. The ball displays the slip condition. The pointer displays the direction and rate of the turn. The circuit is powered by the 28 Vdc essential bus and protected by the TURN & SLIP IND circuit breaker.

2-71. Vertical Velocity Indicator.

The pilot vertical velocity indicator (figure 2-6) displays the helicopter ascent and descent speed in feet per minute. The indicator is actuated by the rate of atmospheric pressure change.

2-72. Free Air Temperature (FAT) Indicator.

The pilot FAT indicator (figure 2-4) displays the outside air temperature in celsius degrees.

2-73. Magnetic (Standby) Compass.

The gunner magnetic compass (figure 2-5) displays the magnetic heading of the helicopter. A compass correction card is attached to the compass.

2-74. Radio Aids to Navigation.

The FM radio, automatic directional finder, course indicator, and radio magnetic indicator are radio aids to navigation and are covered in Chapter 3.

2-75. Master Caution System.

a. Master Caution Lights. The pilot and gunner master CAUTION lights (figures 2-6 and 2-7) illuminate when fault conditions occur. This illumination alerts the pilot and gunner to check his caution panel for the specific fault condition. The blue-green cover must be closed when operating in the night vision environment to prevent light blindess; and open when operating in the normal environment to provide proper visibility.

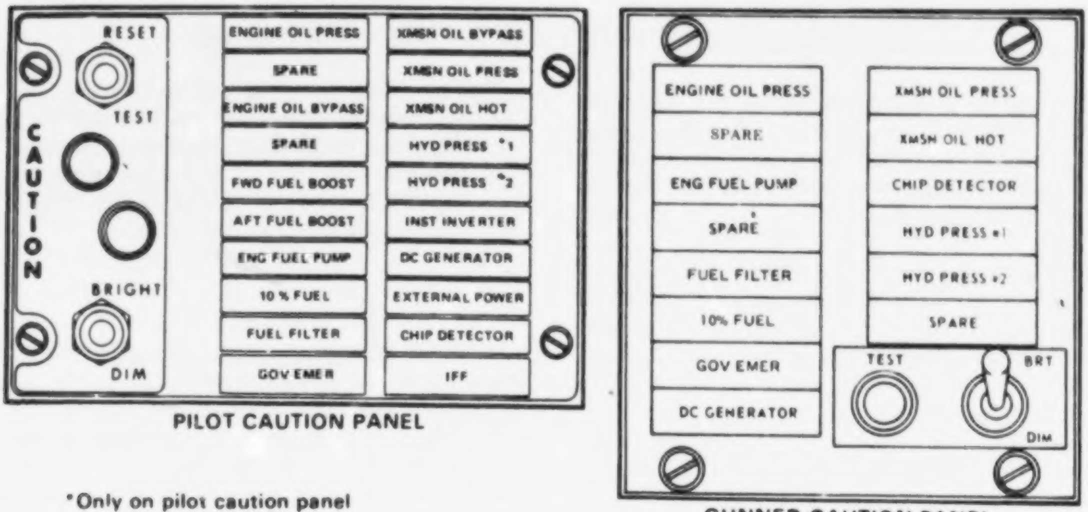
b. Caution Panels (figure 2-18).

(1) *Caution Panel Lights.* The pilot and gunner caution panels lights illuminate to identify specific fault conditions. The caution light lettering is readable only when the light illuminates. The light will remain illuminated until the fault condition is corrected or the light panel is rotated in the caution panel.

(2) *Test/Reset and Test Switches.* The pilot caution panel has a TEST/RESET switch. The gunner caution panel has a TEST switch. Momentarily placing the pilot switch in the TEST position will cause both MASTER CAUTION lights to illuminate. All caution lights on the pilots panel and all caution lights except two spares on the gunners caution panel will illuminate. Momentarily placing the gunners switch in the TEST position will illuminate all lights on the gunners caution panel.

(3) *Bright-Dim Switches.* The caution panels have a BRIGHT-DIM (pilot), BRT-DIM (gunner) switch to control the brightness of the panel caution lights and the master CAUTION lights. This switch will not function if the pilot CONSOLE LTS rheostat (figure 2-17) or the gunner INST LTS rheostat (figure 2-10) is in the OFF position. The caution panel lights and the master CAUTION lights will be at full brightness when the pilot/gunner rheostats are in the OFF position.

c. Electrical Circuit. The master caution system is powered by the 28 Vdc essential bus and protected by the CAUTION LTS circuit breaker.


RESET
TEST
CAUTION
BRIGHT
DIM
ENGINE OIL PRESS
SPARE
ENGINE OIL BYPASS
SPARE
FWD FUEL BOOST
AFT FUEL BOOST
ENG FUEL PUMP
10 % FUEL
FUEL FILTER
GOV EMER
XMSN OIL BYPASS
XMSN OIL PRESS
XMSN OIL HOT
HYD PRESS *1
HYD PRESS *2
INST INVERTER
DC GENERATOR
EXTERNAL POWER
CHIP DETECTOR
IFF
ENGINE OIL PRESS
SPARE
ENG FUEL PUMP
SPARE
FUEL FILTER
10% FUEL
GOV EMER
DC GENERATOR
XMSN OIL PRESS
XMSN OIL HOT
CHIP DETECTOR
HYD PRESS #1
HYD PRESS #2
SPARE
TEST
BRT
DIM

PILOT CAUTION PANEL

GUNNER CAUTION PANEL

*Only on pilot caution panel

CAUTION PANEL WORDING	FAULT CONDITIONS
ENGINE OIL PRESS	Engine oil pressure below operating minimum (25 psi).
* ENGINE OIL BYPASS	Engine oil bypass switch OFF — Oil system level down 3.8 quarts from full. Engine oil bypass switch AUTOMATIC — Oil system level down 3.8 quarts from full and bypassing cooler.
* FWD FUEL BOOST	Forward fuel boost pump pressure low (below 5 psi).
* AFT FUEL BOOST	Aft fuel boost pump pressure low (below 5 psi).
ENG FUEL PUMP	One side and/or both sides of engine fuel pump producing low pressure.
10% FUEL	Low fuel quantity.
FUEL FILTER	Fuel filter is partially obstructed.
GOV EMER	Governor switch in emergency position.
* XMSN OIL BYPASS	Transmission oil bypassing oil cooler.
XMSN OIL PRESS	Transmission oil pressure is below minimum (below 30 psi).
XMSN OIL HOT	Transmission oil temperature is at or above red line.
HYD PRESS #1	System 1 hydraulic pressure is low.
HYD PRESS #2	System 2 hydraulic pressure is low.
* INST INVERTER	AC power lost.
DC GENERATOR	DC generator has failed.
* EXTERNAL POWER	External power receptacle door open.
CHIP DETECTOR	Metal particles in transmission, engine, 42 degree gearbox, or 90 degree gearbox.
* IFF	Mode 4 is inoperative or has failed to reply to a Mode 4 interrogation.

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Figure 2-18. Pilot and gunner caution panels

2-76. Engine Fire Detection System.

a. General. The system provides the pilot and gunner with a visual indication of a fire in the engine compartment. The system is powered by the 28 Vdc essential bus and protected by the FIRE DET circuit breaker.

b. Fire Detector Light. The FIRE light (figures 2-4 and 2-7) illuminates when sensing elements detect excessive heat in the engine compartment. The sensing elements are attached to the tail rotor driveshaft tunnel, fire wall and heat shield. The blue-green cover must be closed when operating in the night vision environment to prevent light blindness; and open when operating in the normal environment to provide proper visibility.

c. Fire Detector Test Switch. Holding the pilot FIRE DETECTOR TEST switch (figure 2-4) in the ON position will cause the FIRE light to illuminate. This illumination indicates that the system is operational.

2-77. RPM High-Low Limit Warning System.

The system provides an immediate warning to check instruments for high or low rotor rpm or low engine rpm. The light warning and audio warning functions when the following rpm conditions exist:

Light Warning and Audio Warning in Combination	For rotor rpm of 305 ± 5 rpm or below (corresponds to engine rpm of 6200 ± 100 rpm or below) (low warning).
Light Warning Only	For rotor rpm of 334 ±5 (corresponds to engine rpm ot 6800 ± 100) (high warning).

NOTE

The audio warning will be heard in the pilot and gunner headsets. The audio is a varying oscillating frequency starting low and building up to a high pitch, on for 0.85 second interval, then off for 1.25 second, then repeating cycle.

a. RPM Warning Light. The pilot RPM light (figure 2-4) illuminates to provide a visual warning of high or low rotor rpm or low engine rpm. The blue-green cover must be closed when operating in the night vision environment to prevent light blindness; and open when operating in the normal environment to provide proper visibility.

NOTE

For low rpm warning, the audio warning functions in conjunction with the light.

b. RPM Switch — Low Audio. The pilot RPM switch (figure 2-9) OFF position prevents audio warning from functioning for engine starting when the audio might be objectionable. The switch automatically resets to WARNING position when the engine and rotor reach normal rpm.

c. Electrical Circuit. The RPM high-low limit warning system is powered by 28 Vdc essential bus and protected by the RPM WARN SYS circuit breaker.

Section XIV. SERVICING, PARKING, AND MOORING

2-78. Servicing.

a. Servicing Diagram. Refer to figure 2-19.

b. Approved Military Fuels, Oils Fluids, and Unit Capacities. Refer to figure 2-20.

2-78A. Fuel System Servicing.

WARNING

Servicing personnel shall comply with all safety precautions and procedures specified in FM 10-68 Aircraft Refueling field manual.

CAUTION

Ensure that servicing unit pressure is not above 125 psi while refueling.

a. Refer to Figure 2-20 for fuel tank capacities.

b. Refer to Figure 2-21 for approved fuel.

c. The Helicopter may be serviced by any of the methods described as follows:

(1) *Closed Circuit Refueling (Power Off).*

(a) Refer to Figure 2-19 for fuel filler location.

(b) Assure that fire guard is in position with fire extinguisher.

(c) Ground servicing unit to ground stake.

(d) Ground servicing unit to Helicopter.

(e) Ground fuel nozzle to ground receptacle located adjacent to fuel receptacle on helicopter.

(f) Remove fuel filler cap, and assure that refueling module is in locked position.

(g) Remove nozzle cap and insert nozzle into fuel receptacle and lock into position.

(h) Activate flow control handle to ON or FLOW position. Fuel flow will automatically shut off when fuel cell is full. Just prior to normal shut off, fuel flow may cycle several times, as maximum fuel level is reached.

(i) Assure that flow control handle is in OFF or NO FLOW position and remove nozzle.

(j) Replace fuel nozzle cap.

(k) Replace fuel filler cap.

(l) Disconnect fuel nozzle ground.

(m) Disconnect ground from helicopter to servicing unit.

(n) Disconnect servicing unit ground from ground stake.

(o) Return fire extinguisher to designated location.

(2) *Gravity or Open-Port Refueling (Power Off).*

(a) Refer to Figure 2-19 for fuel filler location.

(b) Assure that fire guard is in position with fire extinguisher.

(c) Ground servicing unit to ground stake.

(d) Ground servicing unit to Helicopter.

(e) Ground fuel nozzle to ground receptacle located adjacent to fuel receptacle on helicopter.

(f) Remove fuel filler cap.

(g) Using latch tool attached to filler cap cable open refueling module, if equipped with closed circuit receptacle.

(h) Remove nozzle cap and insert nozzle into fuel receptacle.

(i) Activate flow control handle to ON or FLOW position. Fuel flow will automatically shut off when fuel cell is full.

(j) Assure that flow control handle is in OFF or NO FLOW position and remove nozzle.

(k) Replace fuel nozzle cap.

(l) Close refueling module by pulling cable until latch is in locked position, if equipped with closed circuit receptacle.

(m) Replace fuel filler cap.

(n) Disconnect fuel nozzle ground.

(o) Disconnect ground from helicopter to servicing unit.

(p) Disconnect servicing unit ground from ground stake.

(q) Return fire extinguisher to designated location.

(3) *RAPID (HOT) Refueling (Closed Circuit).*

(a) Before RAPID Refueling.

1. Throttle - Idle.
2. FORCE TRIM switch - FORCE TRIM.

WARNING

In case of helicopter fire, observe fire emergency procedures in Chapter 9.

(b) During RAPID Refueling. A crewmember shall observe the refueling operation (performed by authorized refueling personnel) and stand fire guard as required. One crewmember shall remain in the helicopter to monitor controls. Only emergency radio transmission should be made during Rapid refueling.

(c) Use same procedure as for Power Off Refueling, Para (1).

(d) After refueling, the pilot shall be advised by the refueling crew or other crewmembers of the following:

1. Fuel cap secured.
2. Grounding cables removed.

(4) RAPID (HOT) GRAVITY Refueling.

(a) Before RAPID Refueling.

1. Throttle - Idle.
2. FORCE TRIM switch - FORCE TRIM.

WARNING

In case of helicopter fire, observe fire emergency procedures in Chapter 9.

(b) During RAPID Refueling. A crewmember shall observe the refueling operation (performed by authorized refueling personnel) and stand fire guard as required. One crewmember shall remain in the helicopter to monitor controls. Only emergency radio transmission should be made during Rapid refueling.

(c) Use same procedure as for Power Off Refueling, Para (1).

WARNING

During RAPID GRAVITY Refueling, exercise extreme caution to prevent fuel splashing from fuel cell or fuel nozzle. Any fuel leakage could be extremely hazardous if ingested into engine air intake.

(d) After refueling, the pilot shall be advised by the refueling crew or other crewmembers of the following:

1. Fuel cap secured.
2. Grounding cables removed.

2-79. Approved Commercial Fuels, Oils, and Fluids.

a. *Fuels.* Refer to figure 2-21.

b. *Oils.* Refer to figure 2-22.

c. *Fluids.* Refer to figure 2-23.

2-80. Types and Use of Fuels.

a. *Fuel Types.*

(1) *Army Standard Fuels.* These are the Army-designated primary fuels adopted for worldwide use, and are the only fuels available in the Army supply system.

(2) *Alternate Fuels.* These are fuels which can be used continuously when Army standard fuel is not available, without reduction of power output. Power setting adjustments and increased maintenance may be required when an alternate fuel is used.

(3) *Emergency Fuels.* These are fuels which can be used if Army standard and alternate fuels are not available. Their use is subject to a specific time limit.

b. *Use of Fuels.*

(1) There is no special limitation on the use of Army standard fuel, but certain limitations are imposed when alternate or emergency fuels are used. For the purpose of recording, fuel mixtures shall be identified as to the major component of the mixture except when the mixture contains leaded gasoline. A fuel mixture which contains over 10 percent leaded gasoline shall be recorded as all leaded gasoline. The use of any fuels other than standard or alternate shall be recorded as all leaded gasoline. The use of any emergency fuels will be recorded in the FAULTS/REMARKS column of DA Form 2408-13, Aircraft Maintenance and Inspection Record, noting the type of fuel, additives, and duration of operation.

(2) The use of kerosene fuels (JP-5-type) in turbine engines dictates the need for observance of special precautions. Both ground starts and air restarts at low temperature may be more difficult due to low vapor pressure. Kerosene fuels having a freezing point of −40 degrees F (−40 degrees C) limit the maximum altitude of a mission to 28,000 feet under standard day conditions. Those having a freezing point of −67 degrees F (−53 degrees C) limit the maximum altitude of a mission to 33,000 feet under standard day conditions.

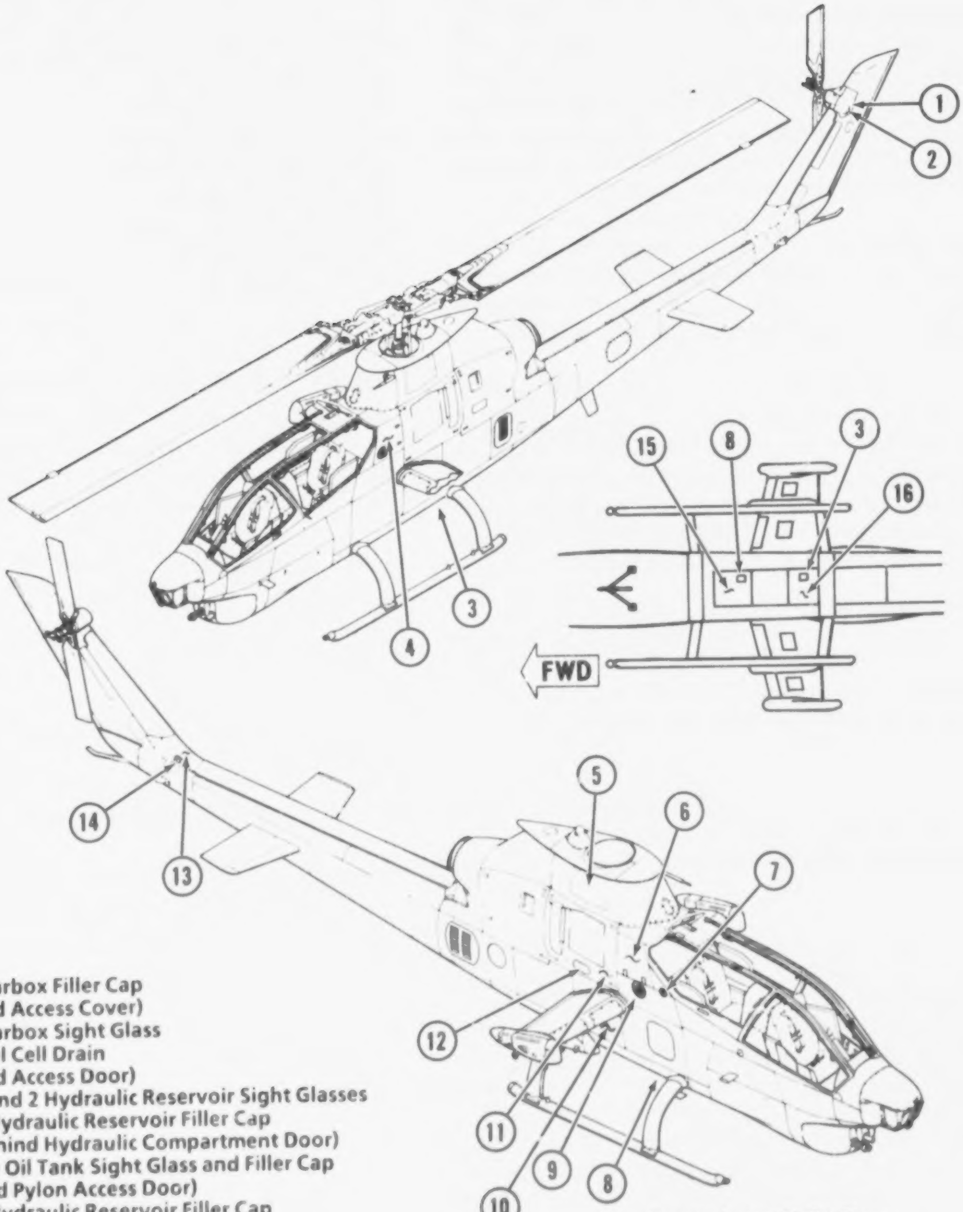
(3) *Mixing of Fuel in Helicopter Tanks.* When changing from one type of authorized fuel to another, for example JP-4 to JP-5, it is not necessary to drain the helicopter fuel system before adding the new fuel.

(4) Fuels having the same NATO code number are interchangeable. Jet fuels conforming to ASTM D-1655 specification may be used when MIL-T-5624 fuels are not available. This usually occurs during cross country flights where helicopters using NATO F-44 (JP-5) are refueled with NATO F-40 (JP-4) or commercial ASTM type B fuels. Whenever this condition occurs, the engine operating characteristics may change in that lower operating temperature, slower acceleration, lower engine speed, easier starting, and shorter range may be experienced. The reverse is true when changing from F-40 (JP-4) fuel to F-44 (JP-5) or commercial ASTM type A-1 fuels. Specific gravity adjustments in fuel controls and flow dividers shall be set for the type of fuel used. Most commercial turbine engines will operate satisfactorily on either kerosene or JP-4 type fuel. However, the difference in specific gravity may possibly require fuel control adjustments; if so, the recommendations of the manufacturers of the engine and air frame are to be followed.

2-80A. Fuel Sample Waiting Time.

The total waiting time before taking a fuel sample is 15 minutes per foot of tank depth for AVGAS and one hour per foot of tank depth for jet (JP) fuels.

2-81. Deleted.



1. 90° Gearbox Filler Cap (Behind Access Cover)
2. 90° Gearbox Sight Glass
3. Aft Fuel Cell Drain (Behind Access Door)
4. No. 1 and 2 Hydraulic Reservoir Sight Glasses No. 1 Hydraulic Reservoir Filler Cap (All Behind Hydraulic Compartment Door)
5. Engine Oil Tank Sight Glass and Filler Cap (Behind Pylon Access Door)
6. No. 2 Hydraulic Reservoir Filler Cap (Behind Hydraulic Compartment Door)
7. Ground Receptacle
8. Forward Fuel Cell Drain (Behind Access Door)
9. Fuel Filler Cap
10. Emergency Collective Accumulator (Behind Access Panel)
11. Transmission Filler Cap (Behind Transmission Compartment Door)
12. Transmission Sight Glass (Behind Viewing Window)
13. 42° Gearbox Filler Cap (Behind Access Cover)
14. 42° Gearbox Sight Glass
15. Forward Fuel Cell Sump Panel
16. Aft Fuel Cell Sump Panel

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Figure 2-19. Servicing diagram (typical)

SYSTEM	SPECIFICATION	NOTE	CAPACITY
Fuel	MIL-5624 (JP-4) MIL-T-5624(JP-4)	1	260 U. S. Gals. Usable 262 U. S. Gals. Total
Oil			
Engine	MIL-L-7808 MIL-L-23699	2, 4 3, 4	
Transmission	MIL-L-7808 MIL-L-23699	2, 4 3, 4	
42° Gearbox	MIL-L-7808 MIL-L-23699	2, 4 3, 4	
90° Gearbox	MIL-L-7808 MIL-L-23699	2, 4	
Hydraulic			
System No. 1	MIL-H-5606 MIL-H-83282	5. 7 6, 7	
System No. 2	MIL-H-5606 MIL-H-83282	5, 7 6, 7	
Reservoir No. 1 & 2	MIL-H-5606 MIL-H-83282	5, 7	

NOTE:

1. MIL-T-5624 (JP-4) NATO code is F-40.
   Alternate fuel is MIL-T-5624 (JP-5) (NATO F-44).
   Emergency fuel is MIL-G-5572 (Any AVGAS) (NATO F-12, F-18, F-22). The helicopter shall not be flown when emergency fuel has been used for a total cumulative time of 50 hours.
2. MIL-L-7808 NATO code is 0-148.
   For use in ambient temperatures below minus 32°C/25°F.
   May be used when MIL-L-23699 oil is not available.
3. MIL-L-23699 NATO code is 0-156.
   For use in ambient temperatures above minus 32°C/25°F.

CAUTION

Under no circumstances shall MIL-L-23699 oil be used in ambient temperatures below minus 32°C/25°F.

4. It is not advisable to mix MIL-L-7808 and MIL-L-23699 oils, except during an emergency. If the oils are mixed, the system shall be flushed within six hours and filled with the proper oil. An entry on DA Form 2408-13 is required when the oils are mixed.
5. MIL-H-5606 NATO code is H-515.
   For use in ambient temperatures below minus 40°C/40°F.
6. For use in ambient temperatures above minus 40°C/40°F.
7. It is not advisable to mix MIL-H-5606 and MIL-H-83282 fluids, except during an emergency. An entry on DA Form 2408-13 is required when the fluids are mixed. When changing from MIL-H-5606 to MIL-H-83282, not more than two percent of MIL-H-5606 may be present in the system.

Figure 2-20. Approved military fuels, oils, fluids, and unit capacities

APPROVED DOMESTIC COMMERCIAL FUELS (SPEC. ASTM-D-1655-70)

MANUFACTURER'S NAME	MANUFACTURER'S DESIGNATION JET B — JP4 NATO F-40	JET A — JP4 NATO NONE	JET A-1 — JP5 NATO F-34
American Oil Co.	American JP-4	American Type A	
Atlantic Richfield	Aerojet B	Aerojet A	Aerojet A-1
Richfield Div		Richfield A	Richfield A-1
B. P. Trading	B.P.A.T.G.		B.P.A.T.K.
Caltex Petroleum Corp.	Caltex Jet B		Caltex Jet A-1
Cities Service Co.		CITGO A	
Continental Oil Co.	Conoco JP-4	Conoco Jet-50	Conoco Jet-60
Gulf Oil	Gulf Jet B	Gulf Jet A	Gulf Jet A-1
EXXON Co, USA	EXXON Turbo Fuel B	EXXON A	EXXON A-1
Mobil Oil	Mobil Jet B	Mobil Jet A	Mobil Jet A-1
Phillips Petroleum	Philjet JP-4	Philjet A-50	
Shell Oil	Aeroshell JP-4	Aeroshell 640	Aeroshell 650
Sinclair		Superjet A	Superjet A-1
Standard Oil Co		Jet A Kerosine	Jet A-1 Kerosine
Chevron	Chevron B	Chevron A-50	Chevron A-1
Texaco	Texaco Avjet B	Avjet A	Avjet A-1
Union Oil	Union JP-4	76 Turbine Fuel	

APPROVED FOREIGN COMMERCIAL FUELS

COUNTRY	JET B — JP4 NATO F-40	JET A — JP5 NATO NONE
Belgium	BA-PF-2B	
Canada	3GP-22F	3-6P-24e
Denmark	JP-4 MIL-T-5624	
France	Air 3407A	
Germany (West)	VTL-9130-006	UTL-9130-007/UTL 9130-010
Greece	JP-4 MIL-T-5624	
Italy	AA-M-C-1421	AMC-143
Netherlands	JP-4 MIL-T-5624	D. Eng RD 2493
Norway	JP-4 MIL-T-5624	
Portugal	JP-4 MIL-T-5624	
Turkey	JP-4 MIL-T-5624	
United Kingdom (Britain)	D. Eng RD 2454	D. Eng RD 2498

NOTE:

Anti-icing and Biocidal Additive for Commercial Turbine Engine Fuel — The fuel system icing inhibitor shall conform to MIL-I-27686. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in helicopter fuel systems. Icing inhibitor conforming to MIL-I-27686 shall be added to commercial fuel, not containing an icing inhibitor, during refueling operations, regardless of ambient temperatures. Refueling operations shall be accomplished in accordance with accepted commercial procedures. Commercial product "PRIST" conforms to MIL-I-27686.

Figure 2-21. Approved commercial fuels — equivalents for JP4 and JP5

All data on page 2-36A/2-36B, including Figure 2-21A is deleted.

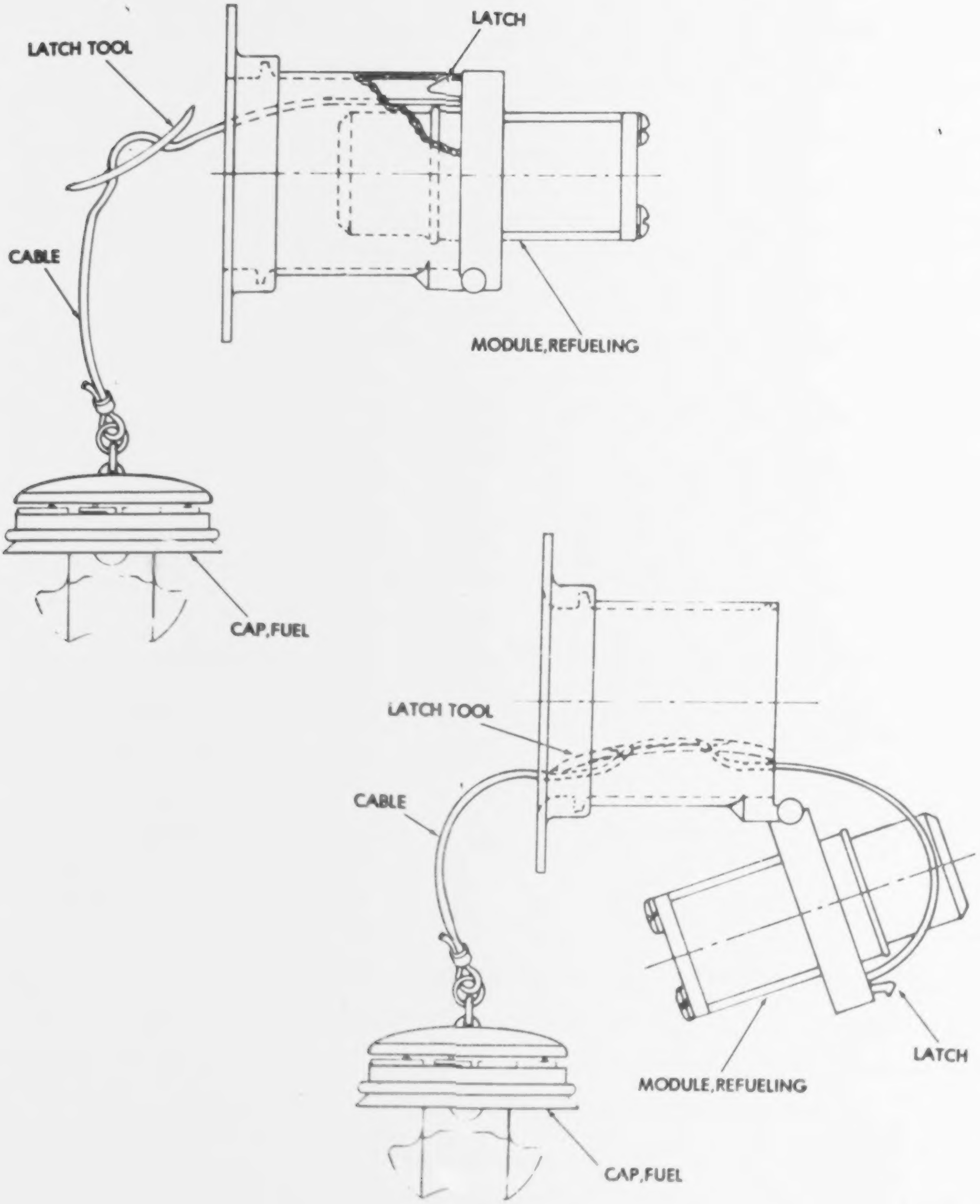

LATCH
LATCH TOOL
CABLE
MODULE,REFUELING
CAP,FUEL
LATCH TOOL
CABLE
LATCH
MODULE,REFUELING
CAP,FUEL

Figure 2-21A. Receiver and Cap Assembly

APPROVED DOMESTIC COMMERCIAL OILS FOR MIL-L-7808

MANUFACTURER'S NAME	MANUFACTURER'S DESIGNATION
American Oil and Supply Co.	PQ Turbine Oil 8365
Humble Oil and Refining Co.	ESSO/ENCO Turbo Oil 2389
Mobile Oil Corp.	RM-184A/RM-201A

CAUTION

Do not use Shell Oil Co., part No. 307, qualification No. 7D-1 oil (MIL-L-7808). It can be harmful to seals made of silicone.

APPROVED DOMESTIC COMMERCIAL OILS FOR MIL-L-23699

MANUFACTURER'S NAME	MANUFACTURER'S DESIGNATION
Americal Oil and Supply Co.	PQ Turbine Lubricant 5247/ 6423/6700/7731/8878/9595
Bray Oil Co.	Brayco 899/899-G/899-S
Castrol Oil Co.	Castrol 205
Chevron International Oil Co., Inc.	Jet Engine Oil 5
Crew Chemical Corp.	STO-21919/STO-21919A/STD 6530
W. R. Grace and Co. (Hatco Chemical Div.)	HATCOL 3211/3611
Humble Oil and Refining Co.	Turbo Oil 2380 (WS-6000)/2395 (WS-6459)/2392/2393
Mobile Oil Corp.	RM-139A/RM-147A/Avrex S Turbo 260/Avrex S Turbo 265
Royal Lubricants Co.	Royco 899 (C-915)/899SC/ Stauffer Jet II
Shell Oil Co., Inc.	Aeroshell Turbine Oil 500
Shell International Petroleum Co., Ltd.	Aeroshell Turbine Oil 550
Standard Oil Co., of California	Chevron Jet Engine Oil 5
Stauffer Chemical Co.	Stauffer 6924/Jet II
Texaco, Inc.	SATO 7377/7730. TL-8090

APPROVED FOREIGN COMMERCIAL OILS FOR MIL-L-7808

Data not available at this time.

APPROVED FOREIGN COMMERCIAL OILS FOR MIL-L-23699

Data not available at this time.

Figure 2-22. Approved commercial oils — equivalents for MIL-L-7808 and MIL-L-23699 oils

APPROVED DOMESTIC COMMERCIAL FLUIDS FOR MIL-H-5606

MANUFACTURER'S NAME	MANUFACTURER'S DESIGNATION
American Oil and Supply Co.	"PO" 4226
Bray Oil Co.	Brayco 757B Brayco 756C Brayco 756D
Castrol Oils, Inc.	Hyspin A
Humble Oil and Refining Co.	Univis J41
Mobile Oil Corp.	Aero HFB
Pennsylvania Refining Co.	Petrofluid 5606B Petrofluid 4607
Royal Lubricants Co.	Royco 756C/D DS-437
Shell Oil Co.	XSL 7828
Standard Oil Co., of California	PED 3565 PED 3337
Texaco, Inc.	TL-5874
Stauffer Chemical Co.	Aero Hydroil 500
Union Carbide Chemical Co.	YT-283
Union Carbide Corp.	FP-221

APPROVED DOMESTIC COMMERCIAL FLUIDS FOR MIL-H-83282

Data not available at this time.

APPROVED FOREIGN COMMERCIAL FLUIDS FOR MIL-H-5606

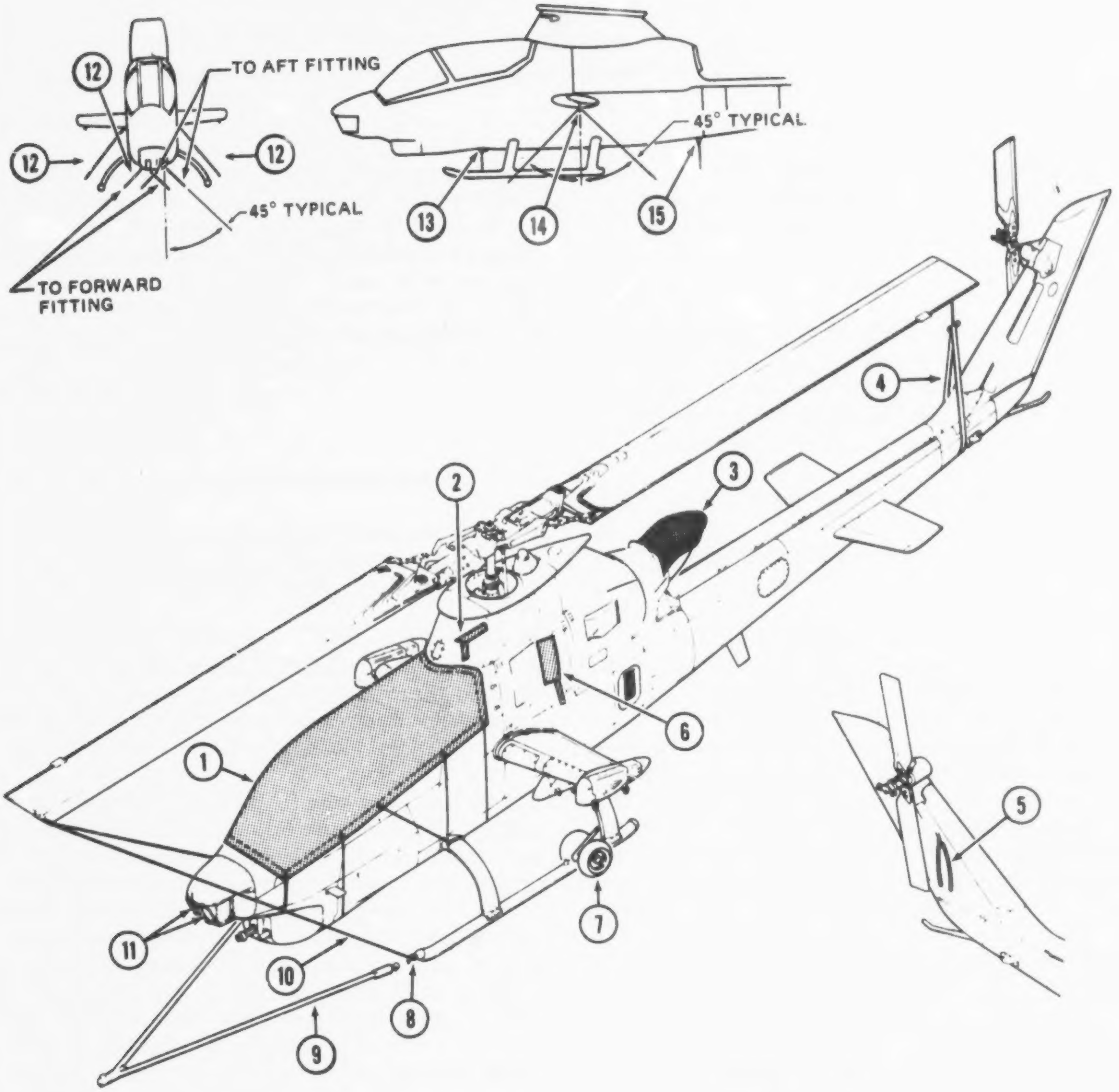
Data not available at this time.

APPROVED FOREIGN COMMERCIAL FLUIDS FOR MIL-H-83282

Data not available at this time.

Figure 2-23. Approved commercial fluids — equivalents for MIL-H-5606 and MIL-L-83282 fluids

All data on page 2-39/2-40, including Figure 2-24 is deleted.


⑫
TO AFT FITTING
⑫
⑫
45° TYPICAL
TO FORWARD FITTING
45° TYPICAL
⑬
⑭
⑮
④
③
②
⑥
①
⑤
⑦
⑪
⑩
⑧
⑨

1. Canopy Cover
2. Pitot Tube Cover
3. Exhaust Cover/IR Duct Cover
4. Aft Main Rotor Tiedown
5. Tail Rotor Tiedown
6. Engine Air Inlet Shield
7. Ground Handling Gear
8. Tow Ring
9. Tow Bar
10. Forward Main Rotor Tiedown
11. TSU Covers
12. One Inch Rope or One-Fourth Inch Cable
13. Forward Mooring Fitting
14. Outboard Pylon Mooring Fitting (LH/RH)
15. Aft Mooring Fitting

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Figure 2-24. Ground handling equipment, covers, rotor tiedowns, and mooring diagram

CHAPTER 3

AVIONICS

3-1. General.

This chapter covers the electronic equipment configuration installed in Army Model AH-1S helicopter. It includes a brief description of the electronic equipment, its technical characteristics, capabilities, and location. This chapter also contains complete operating instructions for all signal equipment installed in the helicopter. For mission avionics equipment, refer to Chapter 4, Mission Equipment.

3-2. Electronic Equipment Configuration.

The configuration consists of headset cordages, keying switches, external interphone receptacles, and the equipment listed in figure 3-1.

a. Headset Cordages. The pilot cordage connector is located to his left, outboard from his collective control stick. The gunner cordage connector is located aft of his cyclic stick and just forward of the canted bulkhead.

b. Keying Switches. A hat type keying switch is located on the pilot and gunner cyclic control stick grips. The aft position of the switch keys the interphone. The forward position of the switch keys the radio selected with the transmit-interphone selector switch on the signal distribution panel. A foot operated type keying switch is located on the right side of the gunner floor. The depressed position of the switch keys the radio or interphone selected with the transmit-interphone selector switch on the gunner signal distribution panel.

c. External Interphone Receptacles. A receptacle is located in each wing tip behind a hinged access door. Headset cordages (with in-the-line keying switches) are provided for adapting the headset to the receptacles.

NOTE

In all radio operations, it is assumed the crew has applied battery or GPU power and circuit breakers are pushed in.

NOTE

The terms "megahertz" and "kilohertz" have replaced the terms "megacycle" and "kilocycle". This chapter will use the terms "megahertz" and "kilohertz" regardless of the equipment markings.

d. Power Supply. Refer to figure 2-14.

3-3. Signal Distribution Panel.

a. Description. Two of the panels are installed in the helicopter. The pilot panel is in the left console. The gunner panel is on his floor forward of his seat. The system is used for intercommunication and radio control. It may be used in any one of three different modes as determined by the setting of the switches and controls on the panel. The three modes of operation are: Two-way radio communication; radio receiver monitoring; and intercommunication between the pilot, gunner, and ground crew.

b. Controls and Functions. Refer to figure 3-3.

c. Operating Procedures.

1. Transmit interphone selector switch — As desired.
2. RECEIVERS switches — As desired.
3. Microphone switch — As desired.
4. VOL control — Adjust.

NOMENCLATURE	COMMON NAME	USE	RANGE
Control, Intercommunication Set C-1611 (*)/ AIC	Interphone Control	Interphone for pilot and gunner; integrates all communication equipment.	Stations within helicopter.
Radio Set AN/ ARC-51BX	UHF Command Radio	Two way voice communication	Line of sight
Radio Set AN/ ARC-54 or AN/ ARC-131	FM Command Radio	Two way voice communication and homing.	Line of sight
Indicator ID-48/ ARN	Course Indicator	FM homing	
Communications Security Equipment TSEC/KY28	Voice Security Equipment	In conjunction with the FM radio set to provide secure two way voice communications	
Radio Set AN/ ARC-134	VHF Radio	Two way voice communication	Line of sight or 50 miles average conditions
Direction Finder Set AN/ARN-83	ADF Set	Radio range navigation	150 to 200 miles average
Gyromagnetic Compass Set AN/ASN-43	Compass Set	Navigation aid	
Transponder Set AN/APX-72	IFF Transponder Radio	Transmit a special coded reply for radar interrogator systems	Line of sight
Proximity Warning Device	Proximity Warning Device	Provides warning of other aircraft, equipped and using PWD system to avoidance of mid-air collision	Line of sight

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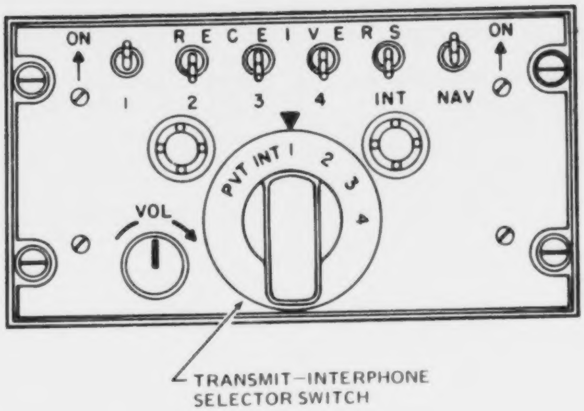
Figure 3-1. Electronic equipment configuration

All data on page 3-3 including figure 3-2 deleted.


ON
R E C E I V E R S
ON
1
2
3
4
INT
NAV
PVT INT 1 2 3 4
VOL
TRANSMIT—INTERPHONE SELECTOR SWITCH

CONTROL	FUNCTION
RECEIVERS switches 1 (FM), 2 (UHF), 3 (VHF), and 4 (not used)	Turns audio from associated receiver ON or OFF
INT switch	ON position enables operator to hear audio from the interphone.
NAV switch	ON position enables operator to monitor audio from the navigation receiver.
VOL control	Adjusts audio on receivers except NAV receivers.
Transmit-interphone selector switch	Positions 1 (FM), 2 (UHF), 3 (VHF), 4 (not used) and INT permits INT or selected receiver-transmitter to transmit and receive. The cyclic stick switch or foot switch must be used to transmit. PVT position keys interphone for transmission.

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Figure 3-3. Signal distribution panel

best copy available

Section I. COMMUNICATIONS

3-4. UHF Command Set.

a. Description. The UHF set provides two-way communication in 3500 channels of the UHF range. A preset channel selector and 20 preset channels are incorporated. Capabilities for monitoring or transmitting/receiving UHF guard frequency are provided. The set is controlled by the panel marked UHF mounted in the pilot right hand console.

b. Controls and Functions. Refer to figure 3-4.

c. Operating Procedures.

1. Function selector switch — T/R (T/R plus G as required).
2. Mode selector switch — PRESET CHAN. Allow set to warm up.
3. RECEIVERS switch No. 2 — Forward position.
4. Frequency — Select.
5. SQ DISABLE switch — OFF.
6. VOL control — Adjust.
7. Transmit interphone selector switch — Position 2.
8. Microphone switch — Press to transmit.
9. Function selector switch — OFF.

d. UHF Guard Frequency Operation. With radio in operation, place the mode selector to the GD XMIT position. The set will now transmit or receive frequency 243.0.

NOTE

Do not transmit on emergency (GUARD) frequency except when under actual emergency conditions.

3-5. FM Command Radio.

a. Description. The FM radio, AN/ARC-54 or AN/ARC-131, is mounted in the pilot instrument panel. Frequency range for the AN/ARC-54 is from 30.00 to 69.95 MHz. Frequency range for the AN/ARC-131 is from 30.00 to 75.95 MHz. The set is used for two-way communication. Homing to a known station can be accomplished using the course indicator with this radio.

b. Controls and Functions. Refer to figure 3-5.

c. Operating Procedures.

1. Mode selector switch — PTT or T/R.
2. Frequency — Select.
3. VOL control — Adjust.
4. SQUELCH control -- CARR or as required.
5. Receiver switch No. 1 — Forward position.
6. Transmit interphone selector switch — Position No. 1.
7. Microphone switch — Press to transmit.
8. Homing — Mode selector switch — HOME.

NOTE

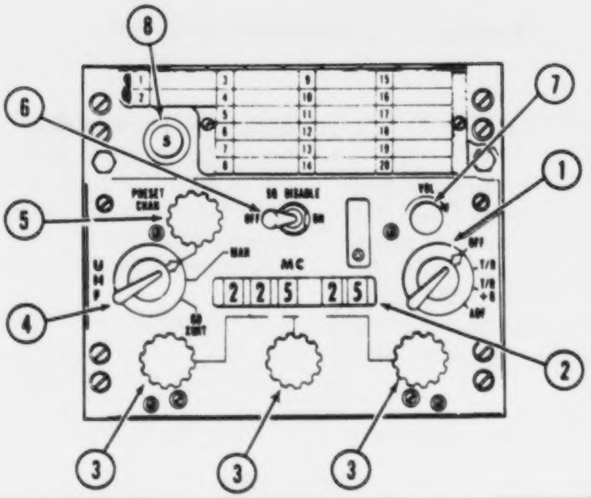
Signal frequencies at 62 MHz and above produce false on-course indications. Final home destination will be achieved but route covered may not be the most direct.

9. Mode selector switch — OFF.

3-6. Course Indicator.

a. Description. The course indicator is located in the pilot instrument panel. This indicator is used only when the FM radio is operating in homing mode.

b. Indicators and Functions. Refer to figure 3-6.



CONTROL	FUNCTION
1. Function Selector	Applies power to radio and selects type of operation.
OFF position	Removes operating power from the set.
T/R position	Transmitter and main receiver ON.
T/R + G position	Transmitter, main receiver and guard receiver ON.
ADF position	Not used.
2. Channel Indicator	Indicates the frequency selected by the frequency controls.
3. Frequency Controls	
Left-hand control	Selects the first two digits of desired frequency.
Center control	Selects the third digit of desired frequency.
Right-hand control	Selects the fourth and fifth digits of the desired frequency.
4. Mode Selector	Determines the manner in which the frequencies are selected as follows:
PRESET CHAN position	Permits selection of one of 20 preset channels by means of preset channel control.
MAN position	Permits frequency selection by means of frequency controls.
GD XMIT position	Receiver-transmitter automatically tunes to guard channel frequency.
5. PRESET CHAN	Permits selection of any of 20 preset channels.
6. SQ DISABLE switch	In the ON position squelch is disabled. In the OFF position the squelch is operative.
7. VOL Control	Controls the receiver audio volume.
8. Preset Channel Indicator	Indicates the preset channel selected by preset channel control.

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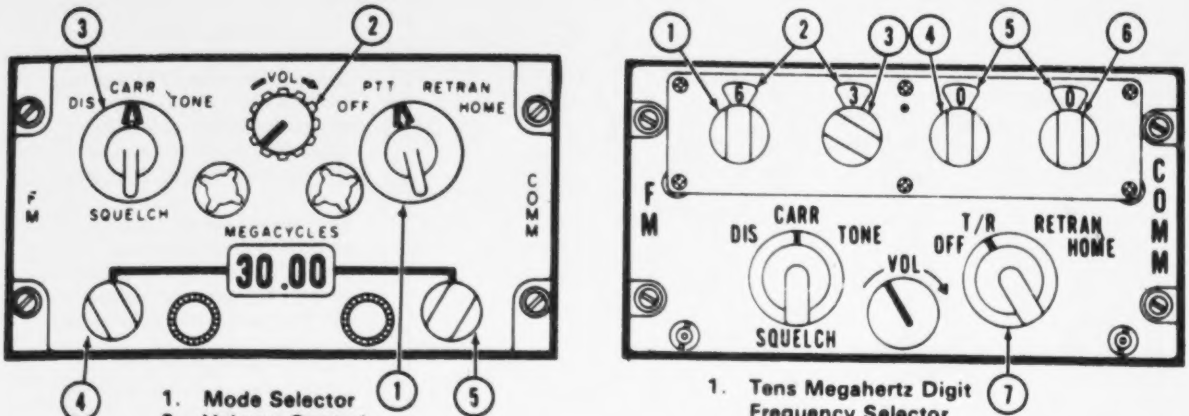
Figure 3-4. UHF Command set


FM
DIS
CARR
TONE
SQUELCH
VOL
PTT
OFF
RETRAN
HOME
COMM
MEGACYCLES
30.00
1
2
3
4
5
FM
COMM
6
3
0
0
DIS
CARR
TONE
SQUELCH
VOL
T/R
OFF
RETRAN
HOME
1
2
3
4
5
6
7

1. Mode Selector
2. Volume Control
3. Squelch Control
4. Whole Megahertz Control
5. Decimal Megahertz Control

FM control panel — AN/ARC-54

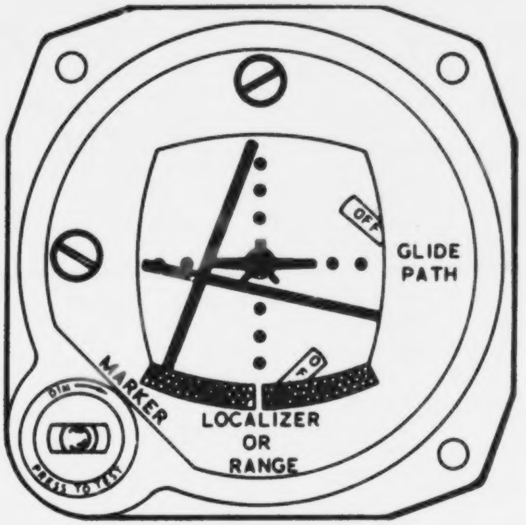
1. Tens Megahertz Digit Frequency Selector
2. Frequency Indicators
3. Units Megahertz Digit Frequency Selector
4. Tenths Megahertz Digit Frequency Selector
5. Frequency Indicators
6. Hundredths Megahertz Digit Frequency Selector
7. Mode Selector Switch

FM control panel AN/ARC-131

CONTROL	FUNCTION
Mode selector	OFF — Turns off power.
	PTT or T/R — Applies power.
	RETRAN — Not applicable.
	HOME — Connects set to homing antenna and course indicator for homing.
VOL control	Adjust audio level.
SQUELCH control	DIS — Squelch disabled.
	CARR — Squelch closed.
	TONE — Squelch opens only on signals containing 150 cps tone modulation.
Whole Megahertz control	Selects the whole megahertz digits of the operating frequency.
Decimal Megahertz control	Selects the decimal megahertz digits of the operating frequency.

209071-337A

Figure 3-5. FM Command radio



INDICATOR	FUNCTION
OFF vertical	Disappears when FM homing circuits are functioning properly. Remains in view when FM homing circuits are not functioning properly.
OFF horizontal flag	Disappears when homing circuits are functioning properly. Remains in view when FM homing circuits are not functioning properly.
Horizontal pointer	Indicate strength of FM homing signal being received. Deflects downward as signal strength increases.
Vertical pointer	Indicates, when pointer is centered that helicopter is flying directly toward or away from the station. Deflection of the pointer indicates the direction (right or left) to turn to fly to the station.
Marker beacon light	Not used.

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Figure 3-6. Course indicator

c. Operating Procedures. Refer to FM Command Radio for course indicator operating procedures.

3-7. Voice Security Equipment.

a. Description. The voice security equipment is used with the FM Command Radio to provide secure two-way communication. The equipment is controlled by the control-indicator mounted in the pilot right console.

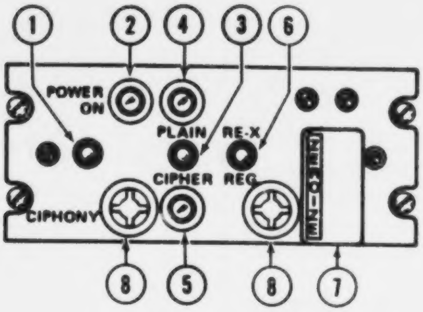
b. Controls, Indicators, and Functions. Refer to figure 3-7.

c. Operating Procedures. Normal operation will exist without its encoder/decoder and control indication being installed in the helicopter. However, two operating modes are available when they are installed. PLAIN mode for unciphered radio transmission or reception and CIPHER mode for ciphered radio transmission or reception. Both modes may be operated with or without retransmission units. Refer to the following to operate the equipment in any particular mode:

1. Preliminary Operating Procedure.

(a) Apply power to FM radio set.

(b) Set the control indicator POWER switch to ON. The POWER switch must be in the ON position, regardless of the mode of operation, whenever the indicator is installed.



CONTROL	FUNCTION
1. POWER ON Switch (Two-Position Circuit Breaker)	Connects power to the associated TSEC/KY-28 cipher equipment in the ON (forward) position, and disconnects power from the equipment in the OFF (aft) position. NOTE Switch must be in the ON (forward) position for operation in the PLAIN or CIPHER mode.
2. POWER ON (Amber) Indicator (With Dimmer Switch)	Lights when the associated POWER ON switch is placed in the ON (forward) position.
3. PLAIN CIPHER Switch (Two-Position Locking Toggle)	In the PLAIN position, permits normal (unciphered) communications on the associated FM radio set. In the CIPHER position, permits ciphered communications on the associated radio set.
4. PLAIN (Red) Indicator (with Dimmer Switch)	Lights when the associated PLAIN-CIPHER switch is in the PLAIN position
5. CIPHER (Green) Indicator (with Dimmer Switch)	Lights when the associated PLAIN-CIPHER switch is in the CIPHER position.
6. RE-X-REG Switch (Two-Position Locking Toggle)	In the RE-X position, permits ciphered communications through a retransmission unit (at a distant location). In the REG position, permits normal ciphered communications or clear text.
7. ZEROIZE Switch (Two-Position Locking Toggle, Under Spring-Loaded Cover)	CAUTION Do not place the ZEROIZE switch in the ON (forward) position unless a crash or capture is imminent. Normally in OFF (aft) position. Placed in ON (forward) position during emergency situations to neutralize and make inoperative the associated TSEC/KY-28 cipher equipment.
8. Panel Lights	Illuminate the control-indicator (controlled by aircraft panel lights).

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Figure 3-7. Voice security equipment

(c) When power is initially applied, an automatic alarm procedure is initiated.

1. A constant tone is heard in the headset and after approximately two seconds the constant tone will change to an interrupted tone.
2. To clear the interrupted tone, depress and release the push-to-talk switch, the interrupted tone will no longer be heard, and the circuit will be in a standby condition ready for either transmission or reception.

CAUTION

No traffic will be passed if the interrupted tone is still heard after depressing and releasing the press-to-talk switch.

(d) Set control unit function switch for desired type of operation (2 and 3 below).

2. *Plain Mode.*

(a) Set the control indicator POWER switch to ON.

(b) Set the PLAIN-CIPHER switch to PLAIN (indicated by red light).

(c) Set the RE-X-REG switch to REG; except when operating with retransmission units, at which time switch will be placed in the RE-X position.

(d) Press the press-to-talk switch and speak into the microphone to transmit. Release the press-to-talk switch for reception.

3. *Cipher Mode.*

(a) Set the PLAIN-CIPHER switch to CIPHER switch to CIPHER (indicated by a green light).

(b) Place the RE-X-REG switch to REG except when operating wit retransmission units, at which tim the switch will be placed in RE- position:

(c) To transmit, press the press-to-tal switch. DO NOT TALK; i approximately one-half second, beep will be heard. This indicates th receiving station is now capable o receiving your message Transmission can now commence.

NOTE

Only one voice security system can transmit on a given frequency. Always listen before attempting to transmit to assure that no one else is transmitting.

(d) When transmission is complete release the press-to-talk switch. This will retu equipment to the standby condition.

(e) To receive, it is necessary for anoth station to send you a signal first. Upon receipt o signal, the cipher equipment will be switch automatically to the receive condition, which w be indicated by a short beep heard in the heads Reception will then be possible. Upon loss of t signal, the cipher equipment will be automatical returned to the standby condition.

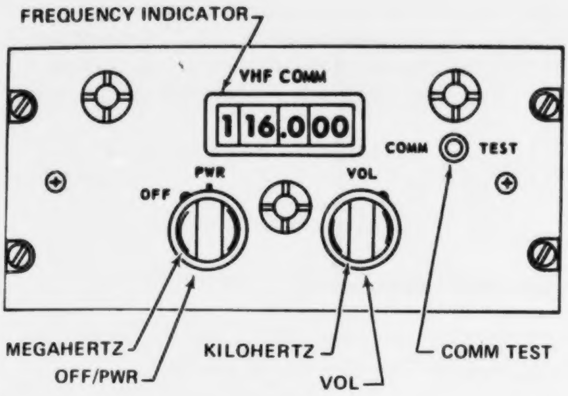
3-8. VHF Radio Set.

a. Description. The set provide communication in the very high-frequency (VH range of 116.000 through 149.975 MHz. Th provides 1360 channels spaced 25 KHz apart. Th control panel is installed on the gunner flo immediately forward of his seat.

b. Controls and Function. Refer to figure 3-

c. Operating Procedures.

1. OFF/PWR switch — PWR. Allow set t warmup.
2. Frequency — Select.
3. RECEIVERS switch No. 3 — Forwar position.



CONTROL	FUNCTION
OFF-PWR switch	Turns power to the set ON-OFF.
VOL control	Controls receiver audio volume.
COMM — TEST switch	Turns squelch on or off.
Megahertz control	Selects whole number part of operating frequency.
Kilohertz control	Selects the decimal number part of operating frequency.

209073-17E

Figure 3-8. VHF Radio set

4. VOL — Adjust. If signal is not audible with VOL control full clockwise press COMM TEST switch to unsquelch circuits.

5. Transmit-interphone selector switch — Position 3.

6. Microphone switch — Press to transmit.

7. OFF/PWR switch — OFF.

Section II. NAVIGATION

3-9. ADF Set.

a. Description. The direction finder set provides radio aid to navigation. It operates in the frequency range of 190 to 1750 KHz. When operating as an automatic direction finder, the system presents a continuous indication of the bearing to the station by the number 1 pointer of the radio magnetic indicator. It also provides audio from the station. When operating the loop mode, the system enables the operator to find the bearing to the station by manually controlling the null direction of the directional antenna. The system also operates as a radio receiver to receive voice and unmodulated transmission in the ANT mode. The control panel is marked ADF and is located in the pilot right console.

b. Controls, Indicators and Functions. Refer to figure 3-9.

c. Operating Procedures.

1. Receiver switch (NAV) — ON.

2. Mode selector switch — As desired. Allow set to warmup.

3. FREQUENCY — Select.

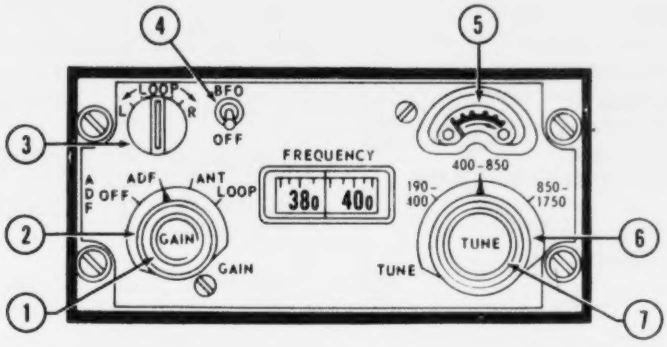
    (a) ADF OPERATION.

    1. Mode selector switch — ADF.

    2. BFO-OFF switch — OFF.

    3. TUNE meter — Tune for maximum deflection.

    4. Volume — Adjust.



CONTROL OR INDICATOR	FUNCTION
1. GAIN control	Controls receiver audio volume.
2. MODE selector switch	ADF — Automatic direction finding showing station direction. ANT — Low frequency radio station receiver. LOOP — Manual direction finding or aural null operation. OFF — Removes power from set.

CONTROL OR INDICATOR	FUNCTION
3. LOOP L-R switch	Rotates loop antenna to the right or left when in LOOP mode.
4. BFO switch	Turns beat frequency oscillator on or off.
5. Tuning meter	Facilitates açcurate tuning of the receiver.
6. Band selector switch	Selects desired frequency band.
7. Tune control	Selects the desired frequency.

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Figure 3-9. ADF Set

(b) *Antenna Operation.*

1. Mode selector switch — ANT.
2. Volume — Adjust.

(c) *Manual Loop Operaiton.*

1. Mode selector switch — LOOP.
2. BFO-OFF switch — BFO.
3. Volume — Adjust.
4. Loop switch — Move left or right for null.

4. Mode selector switch — OFF.

3-10. Gyromagnetic Compass Set.

a. *Description:*

1. The gyromagnetic compass set is a direction sensing system which provides a visual indication of the magnetic heading (MAG) of the helicopter. The information which the system supplies may be used for navigation and to control flight path of the helicopter. The system may also be used as a free gyro (DG) in areas where the magnetic reference is unreliable.

2. A radio magnetic indicator is installed in the pilot instrument panel. A second radio magnetic indicator (not shown) is installed in the gunner instrument panel. The gunner indicator is a repeater type instrument similar to the pilot

indicator except that it has no control knobs. The moving compass card on both indicators displays the gyromagnetic compass heading. The number 1 pointer on the indicators indicate the bearing to the station selected on the ADF receiver.

b. Controls and Functions. Refer to figure 3-10.

c. Operating Procedures.

1. INV switch — MAIN or STBY.
2. Radio magnetic indicator (pilot only) — Check power failure indicator is not in view.

   (a) Slaved Gyro Mode

   1. COMPASS switch — MAG.
   2. Synchronizing knob — Center (Null) annunciator.

   NOTE

   The system does not have a "fast-slewing" feature. If the compass is 180° off the correct helicopter heading when the system is energized it will take approximately 30 minutes for the compass to slave to the correct headings.

   3. Magnetic heading — Check.

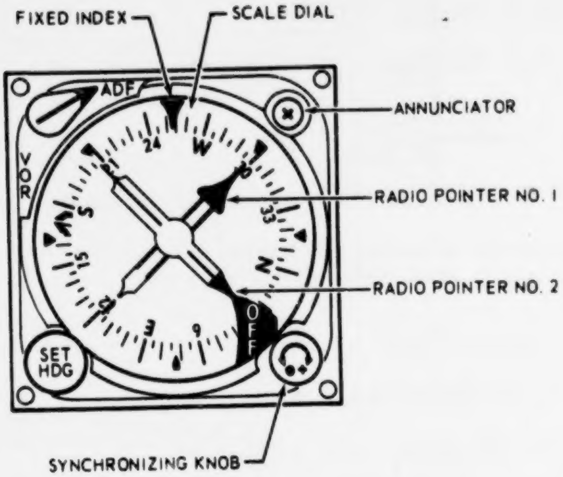
   (b) Free Gyro Mode.

   1. COMPASS switch — DG.
   2. Synchronizing knob — Set heading.
   3. Annunciator — Center position and then does not change (annunciator is de-energized in the free gyro (DG) mode).

   (c) Inflight Operation.

   1. Set the COMPASS switch to DG or MAG as desired for magnetically slaved or free gyro mode of operation. Free gyro (DG) mode is recommended when flying in latitudes higher than 70°.
   2. When operated in the slaved (MAG) mode, the system will remain synchronized during normal flight maneuvers. During violent maneuvers the system may become unsynchronized, as indicated by the annunciator moving off center. The system will slowly remove all errors in synchronization; however, if fast synchronization is desired turn the synchronizing knob in the direction indicated by the annunciator until the annunciator is centered again.
   3. When operating in the free gyro (DG) mode, periodically update the heading to a known reference by rotating the synchronizing knob.

3. INV switch — OFF.


FIXED INDEX
SCALE DIAL
ADF
VOR
ANNUNCIATOR
24
W
30
33
N
S
21
15
12
3
6
OFF
RADIO POINTER NO. 1
RADIO POINTER NO. 2
SET HDG
SYNCHRONIZING KNOB

CONTROL	FUNCTION
Pointer No. 1	Indicates bearing of ADF radio signal.
Pointer No. 2	Not used.
Synchronizing knob	Is manually rotated to null annunciator and synchronize compass system.
SET HDG	Moves the heading select cursor to desired heading.
Heading select cursor	Indicates desired heading.
ADF/VOR knob	Selects ADF or VOR, however, only ADF is used on this installation. Leave knob in ADF position.

CONTROL	FUNCTION
Fixed Index	Provides reference mark for rotating compass card.
Rotating compass card	Rotates under fixed index to indicate helicopter magnetic heading.
Annunciator	Shows dot (•) or cross (+) to indicate misalignment (non-synchronization of compass system.
Power failure indicator (OFF) (flag)	Shows to indications loss of power to compass system.
Compass Switch (located on pilots instrument panel)	MAG position slaves gyro mode DG position free gyro mode

204475-2I

Figure 3-10. Gyromagnetic compass set

Section III. TRANSPONDER AND RADAR

3-11. Transponder Set AN/APX-72.

a. Description. The AN/APX-72 provides radar identification capability. Five independent coding modes are available. Mode 1 provides 32 possible codes which may be selected in flight. Mode 2 provides 4,096 possible codes, but must be preset before flight. Mode 3/A provides 4,096 possible codes which may be selected in flight. Mode C not used in this helicopter. Mode 4 provides IFF capability when coupled with an external computer, and must be preset prior to flight.

b. Controls and Functions. Refer to figure 3-11.

c. Operating Procedures.

1. MASTER control — STBY. Allow approximately 2 minutes for warmup.
2. Mode and code — Select as required.
3. Test as required.
4. MASTER control — LOW, NORM, EMER as required.
5. IDENT — As required.
6. MASTER control — OFF.

d. Emergency Operation — Transponder set.

MASTER control — EMER.

e. MODE 4 Operation.

1. Before Exterior Check.
   - (a) MASTER switch — OFF
   - (b) CODE switch — HOLD
   - (c) CODE HOLD switch (on the pilot's instrument panel) — HOLD. If the CODE HOLD switch is OFF and the MASTER switch is in any position other than — OFF, MODE 4 codes will zeroize when the battery switch is turned off during the BEFORE EXTERIOR check.
2. Aircraft Runup — Test.
   - (a) MASTER switch — STBY for 2 minutes.
   - (b) CODE switch — A.
   - (c) MODE 4 TEST/ON/OUT switch — ON.
   - (e) MODE 4 AUDIO/LIGHT/OUT switch — AUDIO
   - (f) MODE 4 TEST/ON/OUT switch — TEST momentarily. The REPLY light should be on. If the REPLY light is not on or the IFF caution light goes on when the switch is at TEST, a malfunction is indicated and MODE 4 shall not be used. Release the switch to the ON position. Further testing to check for correct coding responses is done with ground test equipment by moving the MASTER switch to NORMAL. When the ground test equipment is moved within 50 feet of the aircraft antenna the following indications should be observed if coding is correct.
   - (g) REPLY light should go on.
   - (h) AUDIO tone should be heard.
   - (i) If the above indications do not occur, select the opposite code (A or B) and repeat the check.
3. Zeroizing. Mode 4 codes may be zeroized by either of the following methods:
   - (a) CODE switch — ZERO.
   - (b) MASTER switch — OFF. If the switch is returned to NORMAL within 15 seconds, zeroizing may not occur.
   - (c) Aircraft electrical power — OFF. If the CODE HOLD switch (on the pilot's instrument panel) is at HOLD and the CODE switch (on transponder) has been moved to HOLD momentarily prior to removing electrical power, zeroizing will not occur in steps (a) and (b) above.

4. Before Takeoff. CODE HOLD switch (on the pilot's instrument panel) — OFF.

5. Engine Shutdown.

   (1) If MODE 4 codes are to be held (not zeroized):

      a. CODE HOLD switch (on the pilot's instrument panel) — HOLD.

      b. CODE switch (on transponder) — Hold position momentarily and release to position A or B (as required).

      c. MASTER switch — OFF.

NOTE

Turn the MASTER switch to OFF within 15 seconds or the electrical hold will replace the mechanical hold and codes will not be retained.

   (2) If MODE 4 codes are to zeroized, use any of the zeroizing methods above.

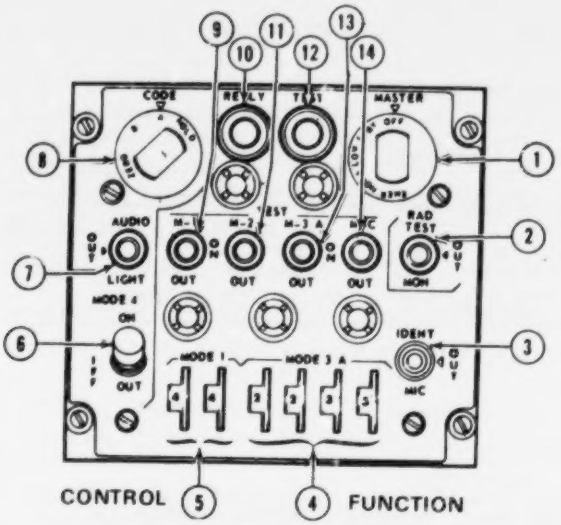
3-12. Radar Warning System AN/APR-39 (V-1).

a. Description. The Radar Warning System AN/APR-39 (V-1) provides the operator with both visual and audible warning when a high radar threat environment is encountered. The system is effectively operated by use of a control, located on the pilots console, and an indicator, located on the instrument panel. A self test is provided to ensure proper operation. The system can sort out, identify threat radar signals, and display identified threats by means of strobes displayed on the indicator. A flashing MA light accompanied by a varying frequency audio tone heard in the operators headset gives indication of a missile alert threat. The direction and proximity range of the threat is displayed by a strobe line on the indicator. If signal strength of threat is increased or threat is coming closer, the strobe line on the indicator will increase in length. A DSCRM switch is provided to enable the operator to remove unwanted radar signals from the indicator.

b. Controls and Functions. Refer to figure 3-12.

c. Operating Procedures.

1. PWR switch — ON.
2. SELF TEST — Depress.
3. DSCRM switch — ON or OFF.
4. AUDIO control — Adjust.
5. BRIL control — Adjust.
6. NIGHT-DAY control — Adjust.
7. PWR switch — OFF.



1. MASTER Control
   - OFF .... Turns set off.
   - STBY .... Places in warmup (standby) condition.
   - LOW .... Set operates at reduced receiver sensitivity.
   - NORM .... Set operates at normal receiver sensitivity.
   - EMER .... Transmits emergency reply signals to MODE 1, 2, or 3/A interrogations regardless of mode control settings.
2. RAD TEST — MON Switch
   - RAD TEST .... Enables set to reply to TEST model interrogations. Other functions of this switch position are classified.
   - MON .... Enables the monitor test circuits.
   - OUT .... Disables the RAD TEST and MON features.
3. IDENT-MIC Switch
   - IDENT .... Initiates identification reply for approximately 25 seconds.
   - OUT .... Prevents triggering of identification reply. Spring loaded to OUT.
   - MIC .... Not used.
4. MODE 3/A Code Select Switches .. Selects and indicates the MODE 3/A four-digit reply code number.
5. MODE 1 Code Select Switches .... Selects and indicates the MODE 1 two-digit reply code number.
6. MODE 4 Switch
   - ON .... Enables the set to reply to MODE 4 interrogations.
   - OUT .... Disables the reply to MODE 4 interrogations.
7. AUDIO-LIGHT Switch
   - AUDIO .... Enables aural and REPLY light monitoring of valid MODE 4 interrogations and replies.
   - LIGHT .... Enables REPLY light,only monitoring of valid MODE 4 interrogations and replies.
   - OUT .... Disables aural and REPLY light monitoring of valid MODE 4 interrogations and replies.
8. CODE Control .... Holds, zeroizes, or changes MODE 4 Codes.
9. M-1 Switch
   - ON .... Enables the set to reply to MODE 1 interrogations.
   - OUT .... Disables the reply to MODE 1 interrogations.
   - TEST .... Provides test of MODE 1 interrogation by indication on TEST light.
10. REPLY Indicator .... Lights when valid MODE 4 replies are present, or when pressed.
11. M-2 Switch
    - ON .... Enables the set to reply to MODE 2 interrogations
    - OUT .... Disables the reply to MODE 2 interrogations.
    - TEST .... Provides test of MODE 2 interrogation by indication on TEST light.
12. TEST Indicator .... Lights when the set responds properly to a M-1, M-2, M-3/A or M-C test, or when pressed.

Note

Computer, transponder must be installed before set will reply to a MODE 4 interrogation.

13. M-3/A Switch
    - ON .... Enables the set to reply to MODE 3/A interrogations.
    - OUT .... Disables the reply to MODE 3/A interrogations.
    - TEST .... Provides test of MODE 3/A interrogation by indication on TEST light.

14 M-C Switch ...... Not applicable on this helicopter.

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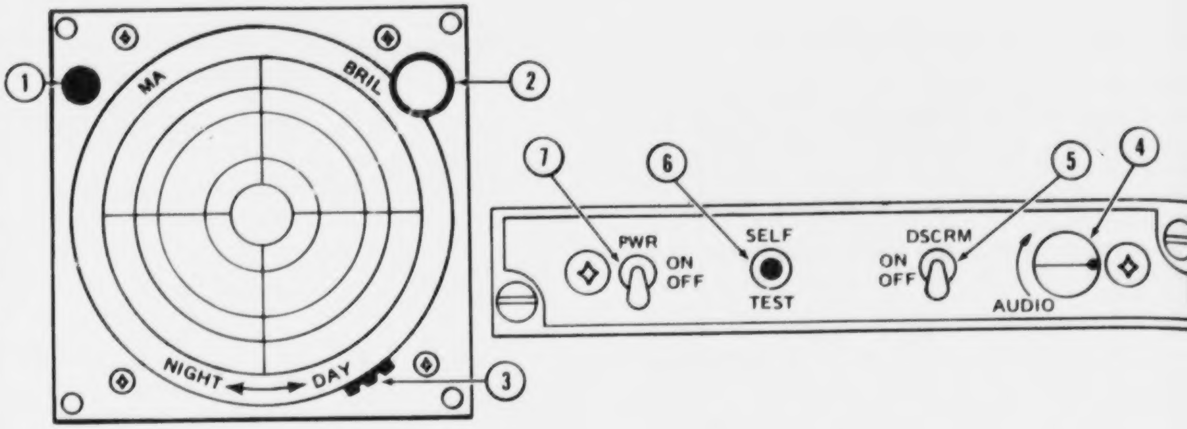
Figure 3-11. Transponder set AN/APX-72



CONTROL/INDICATOR	FUNCTION
1. MA indicator	Flashing indicates high radar missile threat with DSCRM switch in ON.
2. BRIL control	Adjusts indicator illumination.
3. NIGHT—DAY control	Adjust indicator intensity.
4. AUDIO control	Adjusts radar warning audio volume.
5. DSCRM switch:	
OFF	Without missile activity — Provides strobe lines for ground radar and norm audio indications.
	With missile activity — Provides strobe lines for ground radar, flashin strobe line(s) for missile activity, and flashing MA (missile alert) light.
ON	Without missile activity — No indications.
	With missile activity — Flashing strobe lines for missile activity (no strob lines for ground radar), flashing MA light, and audio warning.
6. SELF TEST switch: with DSCRM switch OFF PWR switch ON. (NOTE: One minute warmup) Monitor CRT and audio & press and hold SELF TEST	Forward and aft strobes appear, extending to approximately the third circle o the indicator graticule and 2.5 khz PRF audio present immediately.
Rotate indicator BRIL control CW & CCW	Within approximately 6 seconds, alarm audio present and MA lamp starts flashing
Rotate control unit AUDIO control between maximum CCW and maximum CW	Indicator strobes brighten (CW) and dim as control is rotated.
Release SELF TEST	AUDIOS not audible at maximum CCW and clearly audible at maximum CW.
Set DSCRM to ON. Press & hold SELF TEST	All indications cease. Within approximately 4 seconds a FWD or AFT strobe and 1.2 khz PRF audio presen Within approximately 6 seconds the other strobe will appear and APR audio will double.
7. PWR switch:	
ON	Applies power to radar set.
OFF	De-energizes radar set.

Figure 3-12. Radar Warning Indicator and Control AN/APR-39

CHAPTER 4

MISSION EQUIPMENT

Section I. MISSION AVIONICS

4-1. Gun Camera.

Part of telescopic sight unit. Refer to Chapter 4, Section II.

Section II. ARMAMENT

WARNING: ARMAMENT FIRING

Firing of aircraft weapons in icing conditions is prohibited. The weapons covered are: TOW missile, 2.75 inch FFAR, 40MM Grenade Launcher, 20MM Gun and 7.62MM MG.

A very serious safety hazard exists if aircraft weapons are fired in icing weather conditions. The TOW missile warhead can detonate in close proximity to aircraft. The warhead fuse is damaged as missile is launched through ice in missile launcher. Gun barrels and breechs can rupture if gun muzzles are clogged with ice. The FFAR are held captive in the launcher tubes by the frozen ice.

Helicopter control shall be maintained, especially at low altitude, to prevent hazardous flight conditions and loss of TOW missile control. When the gunner is tracking TOW missile and the pilot using his helmet sight to fire the turret simultaneously, the pilot may have a strong tendency to lose contact with his instrument panel and outside references or develop target fixation.

When firing weapons while using night vision goggles, rocket and TOW exhaust, muzzle flashes, and flares could cause light blindness. Extreme caution should be exercised at all times while in the night vision environment.

4-2. Armament Configuration.

a. Authorized Armament Configurations. Figure 4-1 shows the authorized armament loading configurations.

b. Interrelation of Armament. The armament subsystems are interfaced with one another. Figure 4-2 shows the pilot and gunner control components in relationship to each armament subsystem.

c. Armament Firing Modes. Figure 4-3 shows the switch positions for principle firing modes.

4-3. Description.

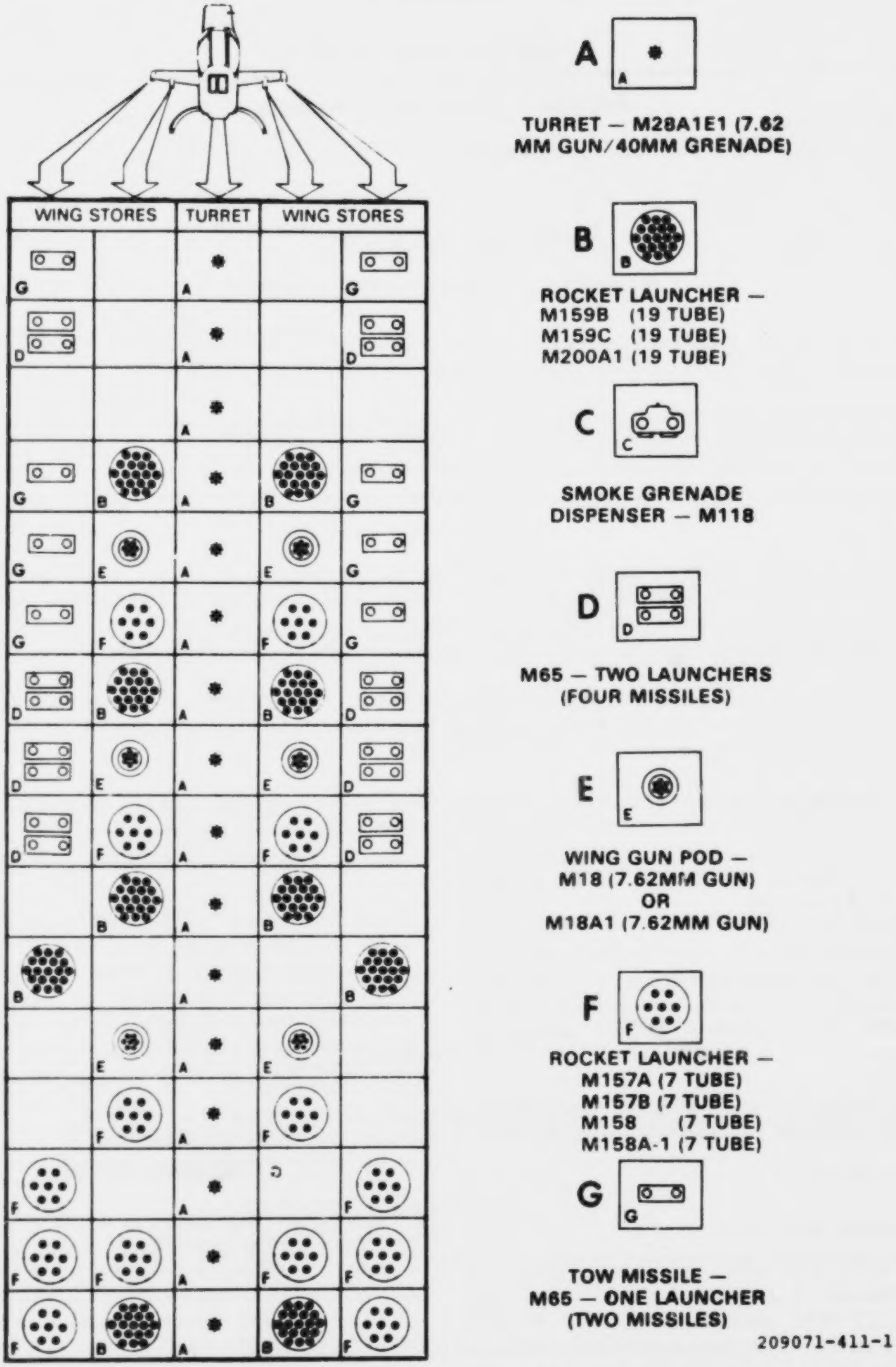
a. System Description.

(1) ***Turret.*** The M28A1E1 turret (figure 4-4) (TM 9-1090-203-12 and TM 9-1090-203-12-1) contains a 7.62 MM machine gun and a 40 MM grenade launcher. The ammunition drums (figure 4-5) are located in the ammunition bay. The turret is hydraulicably and electrically operated. It can be fired in the fixed or flexible mode by the pilot. flexible mode by the gunner. The turret can travel 107.5 degrees left or right in azimuth and 12 to 17.5 degrees up and 50 degrees down in elevation.

(a) Machine Gun. The gun is an electrical driven, automatic, air-cooled, six barrel, and six bolts weapon. The gun is capable of firing six-second bursts at 2000 or 4000 rounds per minute. The ammunition drum stores a maximum of 4000 rounds of linked ammunition in a folding fan arrangement. The drum is driven by the machine gun drive motor through the flexible shaft.

WARNING

To allow safe firing of M129 Grenade Launcher in TSU/GUN mode, do not fire at altitudes below 125 feet AGL. Place turret depression limit switch in ON position. Turret control reverts to Helmet Sight System whenever TOW Missile System is shutdown due to malfunctions on helicopters without MWO 55-1500-220-30-2 incorporated.



WING STORES		TURRET	WING STORES	
G		A		G
D		A		D
		A		
G	B	A	B	G
G	E	A	E	G
G	F	A	F	G
D	B	A	B	D
D	E	A	E	D
D	F	A	F	D
	B	A	B	
B		A		B
	E	A	E	
	F	A	F	
F		A		F
F	F	A	F	F
F	B	A	B	F

A
TURRET — M28A1E1 (7.62 MM GUN/40MM GRENADE)
B
ROCKET LAUNCHER —
M159B (19 TUBE)
M159C (19 TUBE)
M200A1 (19 TUBE)
C
SMOKE GRENADE DISPENSER — M118
D
M65 — TWO LAUNCHERS (FOUR MISSILES)
E
WING GUN POD —
M18 (7.62MM GUN)
OR
M18A1 (7.62MM GUN)
F
ROCKET LAUNCHER —
M157A (7 TUBE)
M157B (7 TUBE)
M158 (7 TUBE)
M158A-1 (7 TUBE)
G
TOW MISSILE —
M65 — ONE LAUNCHER (TWO MISSILES)
209071-411-1

Figure 4-1. Authorized armament configurations (Sheet 1 of 2)

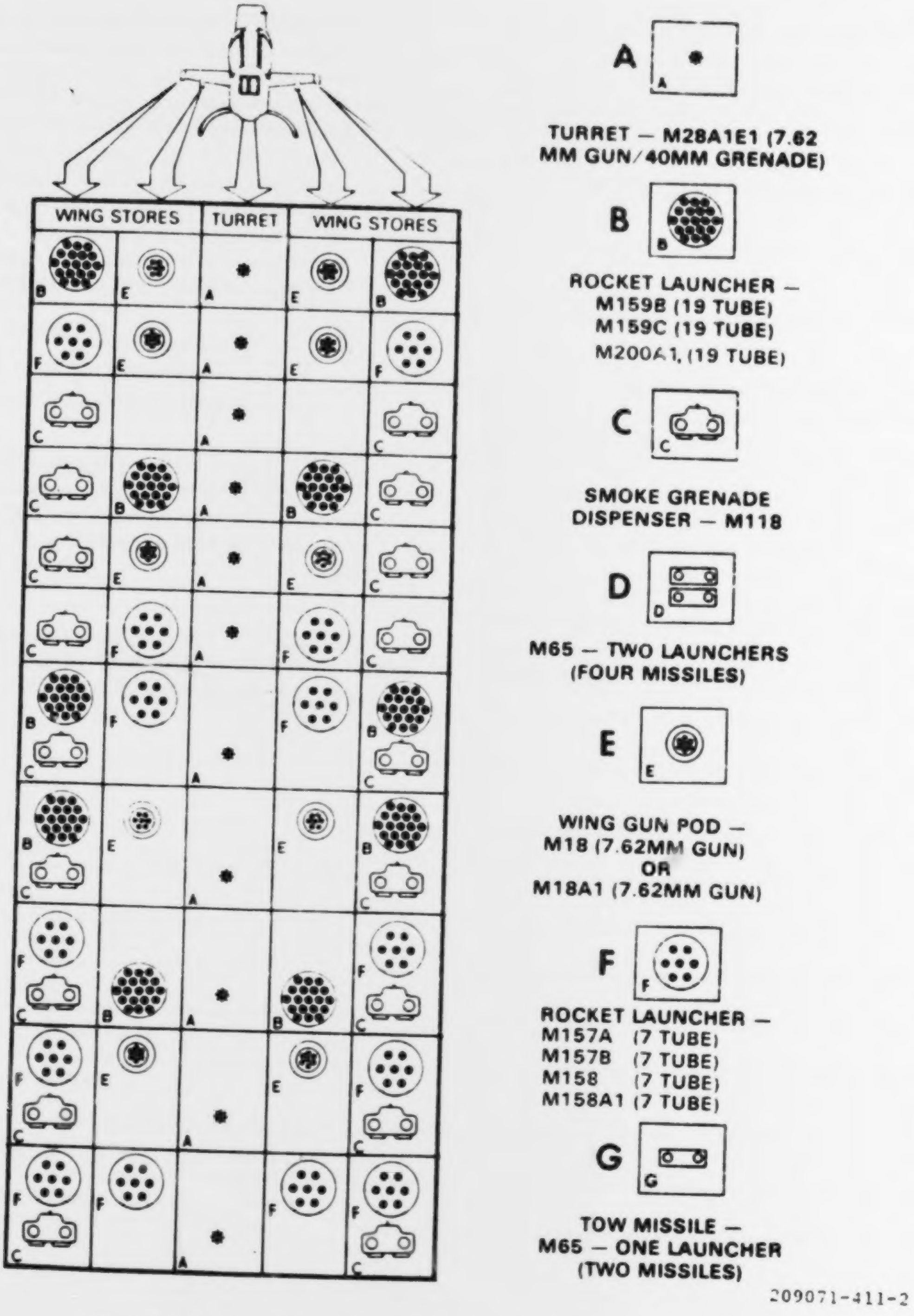

WING STORES
TURRET
WING STORES
B E A E B
F E A E F
C A C
C B A B C
C E A E C
C F A F C
B C F A F B C
B C E A E B C
F C B A B F C
F C E A E F C
F C F A F F C
A
TURRET — M28A1E1 (7.62 MM GUN/40MM GRENADE)
B
ROCKET LAUNCHER — M159B (19 TUBE) M159C (19 TUBE) M200A1, (19 TUBE)
C
SMOKE GRENADE DISPENSER — M118
D
M65 — TWO LAUNCHERS (FOUR MISSILES)
E
WING GUN POD — M18 (7.62MM GUN) OR M18A1 (7.62MM GUN)
F
ROCKET LAUNCHER — M157A (7 TUBE) M157B (7 TUBE) M158 (7 TUBE) M158A1 (7 TUBE)
G
TOW MISSILE — M65 — ONE LAUNCHER (TWO MISSILES)
209071-411-2

Figure 4-1. Authorized armament configuration (Sheet 2 of 2)

(b) Grenade Launcher. The launcher is an electrically driven, rapid-firing, air-cooled weapon. The launcher is capable of firing 10-second burst at 400 grenades per minute. The launcher is cam operated by the gun drive through the flexible shaft. The ammunition drum stores a maximum of 265 linked anti-personnel fragmentation grenades. The drum is electrically driven by a motor mounted on the drum.

(2) ***TOW Missile.*** The TOW (tube-launched, optically-tracked, wire guided) missile subsystem (TM 9-1425-473-20) is a heavy anti-tank/assault weapon. The subsystem utilizes optical and IR (infra-red) means to track a traget and guide the missile. Isolation from helicopter motions and vibrations is provided, thus enabling a high first-hit probability. The subsystem physical characteristics does not degrade the stability and operational characteristics of the helicoter. One or two TML (TOW Missile Launcher) (figure 4-6) support two missiles each on the outboard ejector racks.

NOTE

The subsystem is designed to be effective during daylight conditions. Use at night may be effective if flares are used to augment visibility. Problems with glare on sight reticles, inability to adjust reticle in intensity during target tracking, and difficulty in acquiring targets at unknown locations during darkness, will degrade system performance during night operations.

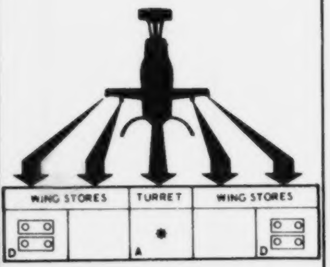
CAUTION

Use of night vision goggles with the TOW sight unit is not recommended since it does not increase visibility and creates a risk of scratching the sight lens.

(3) *Rockets*. The 2.75 inch folding fin aerial rocket (FFAR) (TM 9-1055-460-14) subsystem is light anti-personnel/assault weapon. A launcher

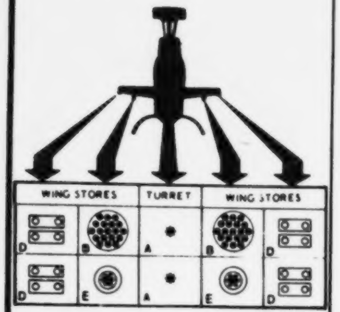
CONTROL COMPONENTS	TURRET	TOW MISSILE	WING STORES		SMOKE GRENADE DISPENSER	TARGET ACQUIRE FOR TSU	WING STORES JETTISON
			ROCKETS	GUN POD			
Pilot Station Armament Control Panel	X	X	X	X	X		
Wing Stores Control Panel			X	X			X
Smoke Grenade Dispenser Control Panel					X		
Smoke Grenade Release Switch					X		
Wing Stores Jettison Switch							X
Pilot Steering Indicator		X					
Missile Status Panel		X					
Gunners Accuracy Control Panel		Training					
Reflex Sight	X		X	X			
Helmet Sight	X					X	
Cyclic Switches	X		X	X			
Gunner Station							
Cyclic Switches	X		X	X			
Helmet Sight	X					X	
Telescopic Sight Unit	X	X					
Left Hand Grip	X	X				X	
Armament Control Panel	X		X	X			
Wing Stores Jettison Switch							X
Sight Hand Control	X	X				X	
TOW Control Panel	X	X				X	

Figure 4-2. Control components in relationship to armament subsystem.

ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES							CAN		USING	
	MASTER ARM	WPN CONT	WG ST ARM	SMOKE ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ	GUNNER	PILOT	FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR			OFF		OFF			Gnr		Tur		HS	LHG
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
								TRK		Gnr		Tur		TSU	LHG
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							STBY TOW	STOW			Plt	Tur		HS	Cyc
								TRK			Plt	Tur		HS	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							ARMED	STOW			Plt	Tur		HS	Cyc
								TRK		Gnr		TOW		TSU	LHG
											Plt	Tur		HS	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
		PLT			OFF						Plt	Tur		HS	Cyc
		FIXED			OFF						Plt	Tur		Reflex	Cyc
					OVRD					Gnr		Tur		HS	Cyc

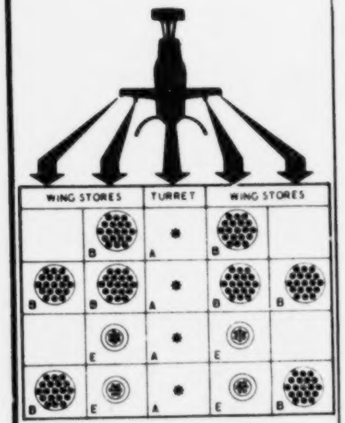
209071-357-1

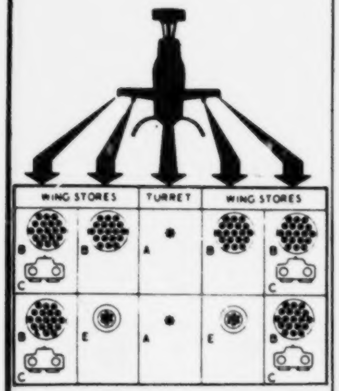
Figure 4-3. Armament firing modes (Sheet 1 of 7)

ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	WG ST ARM	SMOKE ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
 WING STORES TURRET WING STORES D B A B D D E A E D	ARM	GNR	INBD		OFF		OFF			Gnr		Tur		HS	LHG
											Plt	Inbd		Reflex	Cyc
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
											Plt	Inbd		Reflex	Cyc
								TRK		Gnr		Tur		TSU	LHG
											Plt	Inbd		Reflex	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							STBY TOW	STOW			Plt	Tur		HS	Cyc
												Inbd		Reflex	Cyc
								TRK			Plt	Tur		HS	Cyc
												Inbd		Reflex	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							ARMED	STOW			Plt	Tur		HS	Cyc
												Inbd		Reflex	Cyc
								TRK		Gnr		TOW		TSU	LHG
											Plt	Tur		HS	Cyc
												Inbd		Reflex	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
		PLT	INBD		OFF						Plt	Tur		HS	Cyc
												Inbd		Reflex	Cyc
		FIXED	INBD		OFF						Plt	Tur		Reflex	Cyc
												Inbd		Reflex	Cyc
					OVRD	INBD				Gnr		Tur		HS	Cyc
												Inbd		None	Cyc

209071-357-2

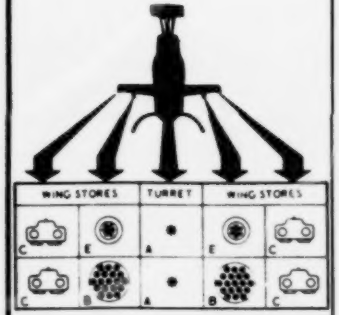
Figure 4-3. Armament firing modes (Sheet 2 of 7)

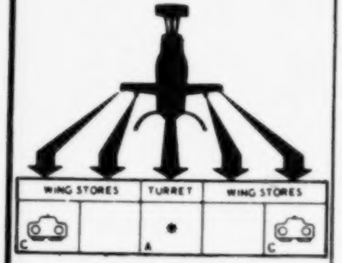
ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	WG ST ARM	SMOKE ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR	INBD/ OUTBD		OFF		OFF			Gnr		Tur		HS	LHG
											Plt	Ws		Reflex	Cyc
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
											Plt	Ws		Reflex	Cyc
								TRK		Gnr		Tur		TSU	LHG
											Plt	Ws		Reflex	Cyc
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							STBY TOW				Plt	Tur		HS	Cyc
												Ws		Reflex	Cyc
							ARMED				Plt	Tur		HS	Cyc
												Ws		Reflex	Cyc
		PLT	INBD/ OUTBD		OFF						Plt	Tur		HS	Cyc
												Ws		Reflex	Cyc
		FIXED	INBD/ OUTBD		OFF						Plt	Tur		Reflex	Cyc
												Ws		Reflex	Cyc
					OVRD	INBD/ OUTBD				Gnr		Tur		HS	Cyc
												Ws		None	Cyc

ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	WG ST ARM	SMOKE ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR	INBD/ OUTBD	ARM	OFF		OFF			Gnr		Tur		HS	LHG
											Plt	Ws		Reflex	Cyc
												Smk		None	Coll
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
											Plt	Ws		Reflex	Cyc
												Smk		None	Coll
								TRK		Gnr		Tur		TSU	LHG
											Plt	Ws		Reflex	Cyc
												Smk		None	Coll
								ACQ		Gnr			Acq	HS	
											Plt	Smk		None	Coll
								TRK	Press		Plt		Acq	HS	
												Smk		None	Coll
							STBY TOW OR ARMED				Plt	Tur		HS	Cyc
												Ws		Reflex	Cyc
												Smk		None	Coll
		PLT	INBD/ OUTBD	ARM	OFF						Plt	Tur		HS	Cyc
												Ws		Reflex	Cyc
												Smk		None	Coll
		FIXED	INBD/ OUTBD	ARM	OFF						Plt	Tur		Reflex	Cyc
												Ws		Reflex	Cyc
												Smk		None	Coll
	STBY			ARM	OFF						Plt	Smk		None	Coll
					OVRD	INBD OUTBD				Gnr		Tur		HS	Cyc
												Ws		None	Cyc

209071-357-4

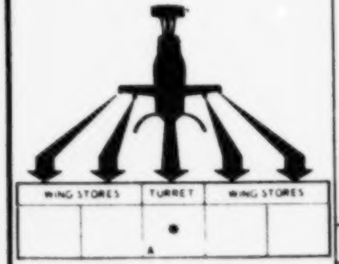
Figure 4-3. Armament firing modes (Sheet 4 of 7)

ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	WG. ST ARM	SMOKE ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
 WING STORES TURRET WING STORES C E A E C C B A B C	ARM	GNR	INBD	ARM	OFF		OFF			Gnr		Tur		HS	LHG
											Plt	Inbd		Reflex	Cyc
												Smk		None	Coll
							TSU/GUN	STOW		Gnr		Tur		HS	LHG
											Plt	Inbd		Reflex	Cyc
												Smk		None	Coll
								TRK		Gnr		Tur		TSU	LHG
											Plt	Inbd		Reflex	Cyc
												Smk		None	Coll
								ACQ		Gnr			Acq	HS	
											Plt	Smk		None	Coll
								TRK	Press		Plt	Smk		None	Coll
													Acq	HS	
							STBY TOW OR ARMED				Plt	Tur		HS	Cyc
												Inbd		Reflex	Cyc
												Smk		None	Coll
		PLT	INBD	ARM	OFF						Plt	Tur		HS	Cyc
												Inbd		Reflex	Cyc
												Smk		None	Coll
		FIXED	INBD	ARM	OFF						Plt	Tur		Reflex	Cyc
												Inbd		Reflex	Cyc
												Smk		None	Coll
	STBY			ARM							Plt	Smk		None	Coll
					OVRD	INBD				Gnr		Tur		HS	Cyc
												Inbd		None	Cyc

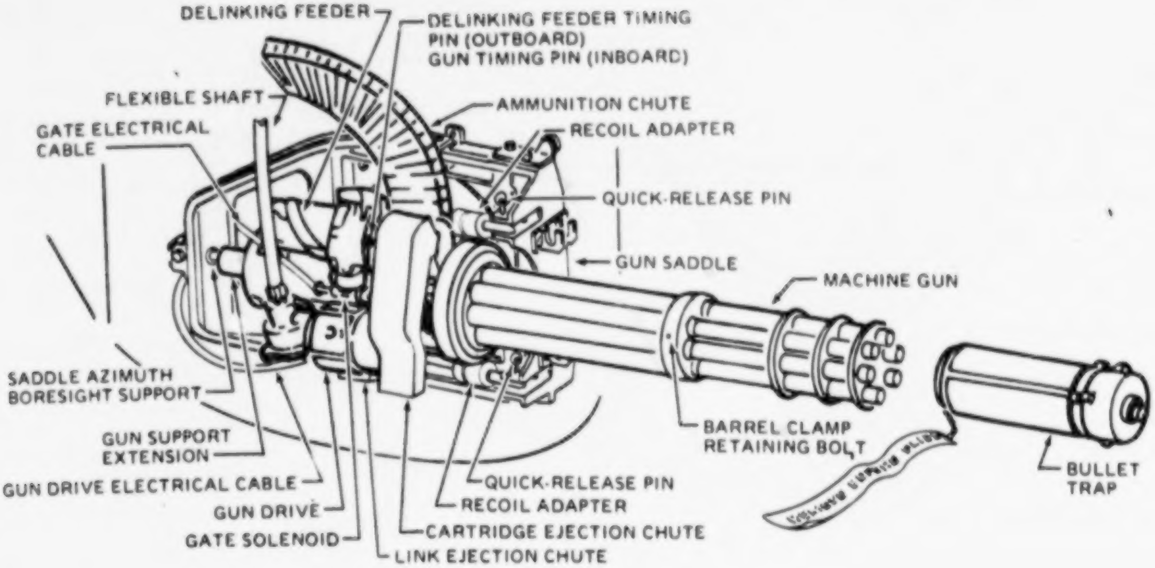
ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	WG ST ARM	SMOKE ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR		ARM	OFF		OFF			Gnr		Tur		HS	LHG
											Plt	Smk		None	Coll
							TSU/ GUN	STOW		Gnr		Tur		HS	LHG
											Plt	Smk		None	Coll
								TRK		Gnr		Tur		TSU	LHG
											Plt	Smk		None	Coll
								ACQ		Gnr			Acq	HS	
											Plt	Smk		None	Coll
								TRK	Press		Plt		Acq	HS	
												Smk		None	Coll
							STBY TOW				Plt	Tur		HS	Cyc
												Smk		None	Coll
							ARMED				Plt	Tur		HS	Cyc
												Smk		None	Coll
		Plt		ARM	OFF						Plt	Tur		HS	Cyc
												Smk		None	Coll
		FIXED		ARM	OFF						Plt	Tur		Reflex	Cyc
												Smk		None	Coll
	STBY			ARM	OFF						PLT	Smk		None	Coll
					OVRD					Gnr		Tur		HS	Cyc

209071-357-6

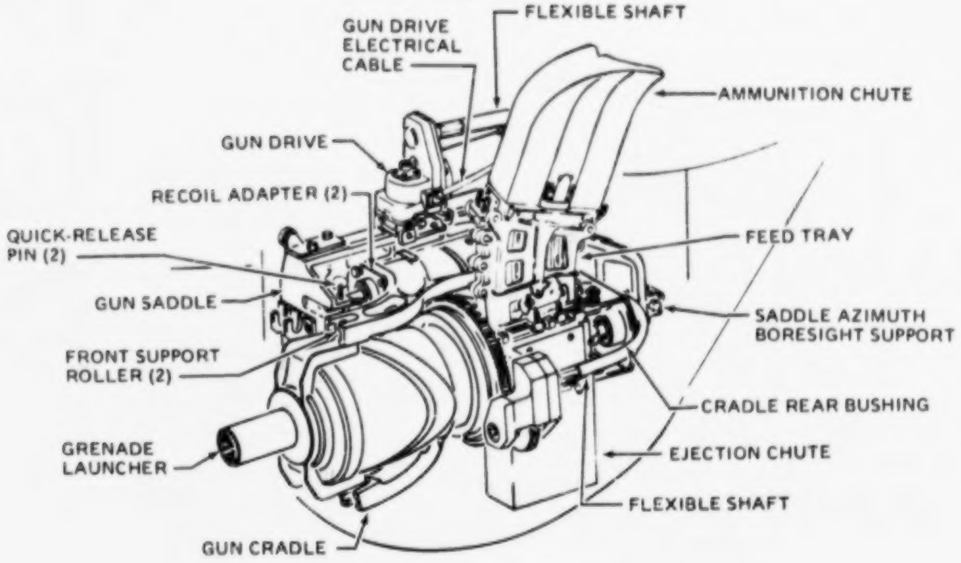
Figure 4-3. Armament firing modes (Sheet 6 of 7)

ARMAMENT CONFIGURATION	PILOT SWITCHES				GUNNER SWITCHES					GUNNER	PILOT	CAN		USING	
	MASTER ARM	WPN CONT	WG ST ARM	SMOKE ARM	PLT OVRD	WING STORES SELECT	MODE SELECT	ACQ TRK STOW	PHS ACQ			FIRE	ACQ TGT FOR TSU	SIGHT	WPN TRIG ON
	ARM	GNR			OFF		OFF			Gnr		Tur		HS	LHG
							TSU/GUN	STOW		Gnr		Tur		HS	LHG
								TRK		Gnr		Tur		TSU	LHG
								ACQ		Gnr			Acq	HS	
								TRK	Press		Plt		Acq	HS	
							STBY TOW				Plt	Tur		HS	Cyc
							ARMED				Plt	Tur		HS	Cyc
		PLT			OFF						Plt	Tur		HS	Cyc
		FIXED			OFF						Plt	Tur		Reflex	Cyc
					OVRD					Gnr		Tur		HS	Cyc

209071-357-7


DELINKING FEEDER
DELINKING FEEDER TIMING PIN (OUTBOARD)
GUN TIMING PIN (INBOARD)
FLEXIBLE SHAFT
AMMUNITION CHUTE
GATE ELECTRICAL CABLE
RECOIL ADAPTER
QUICK-RELEASE PIN
GUN SADDLE
MACHINE GUN
SADDLE AZIMUTH BORESIGHT SUPPORT
BARREL CLAMP RETAINING BOLT
BULLET TRAP
GUN SUPPORT EXTENSION
GUN DRIVE ELECTRICAL CABLE
QUICK-RELEASE PIN
RECOIL ADAPTER
GUN DRIVE
GATE SOLENOID
CARTRIDGE EJECTION CHUTE
LINK EJECTION CHUTE

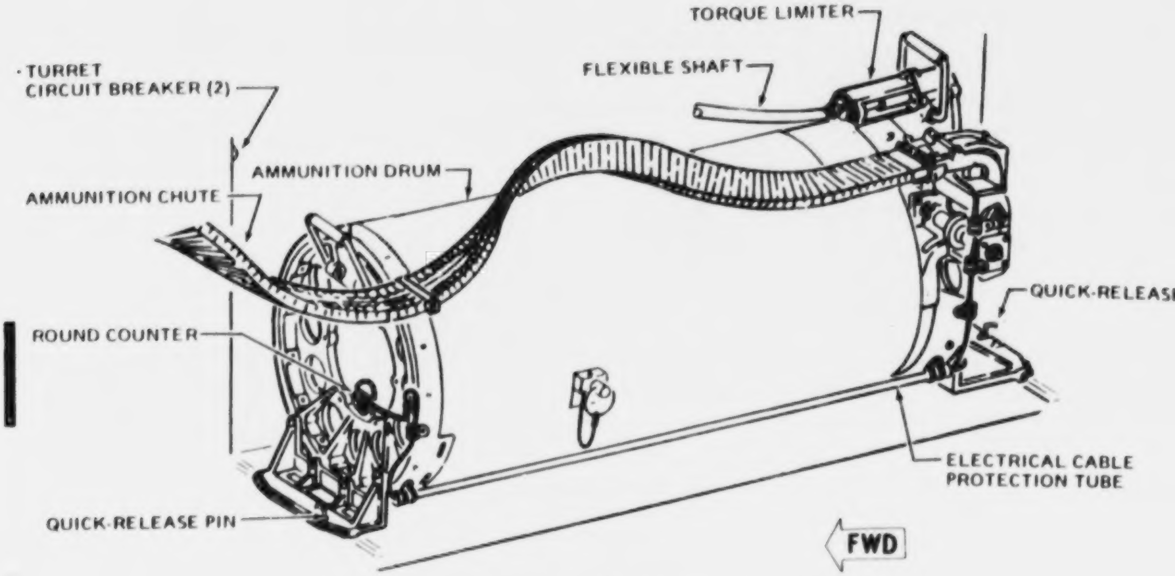
MACHINE GUN


FLEXIBLE SHAFT
GUN DRIVE ELECTRICAL CABLE
AMMUNITION CHUTE
GUN DRIVE
RECOIL ADAPTER (2)
FEED TRAY
QUICK-RELEASE PIN (2)
GUN SADDLE
SADDLE AZIMUTH BORESIGHT SUPPORT
FRONT SUPPORT ROLLER (2)
CRADLE REAR BUSHING
GRENADE LAUNCHER
EJECTION CHUTE
FLEXIBLE SHAFT
GUN CRADLE

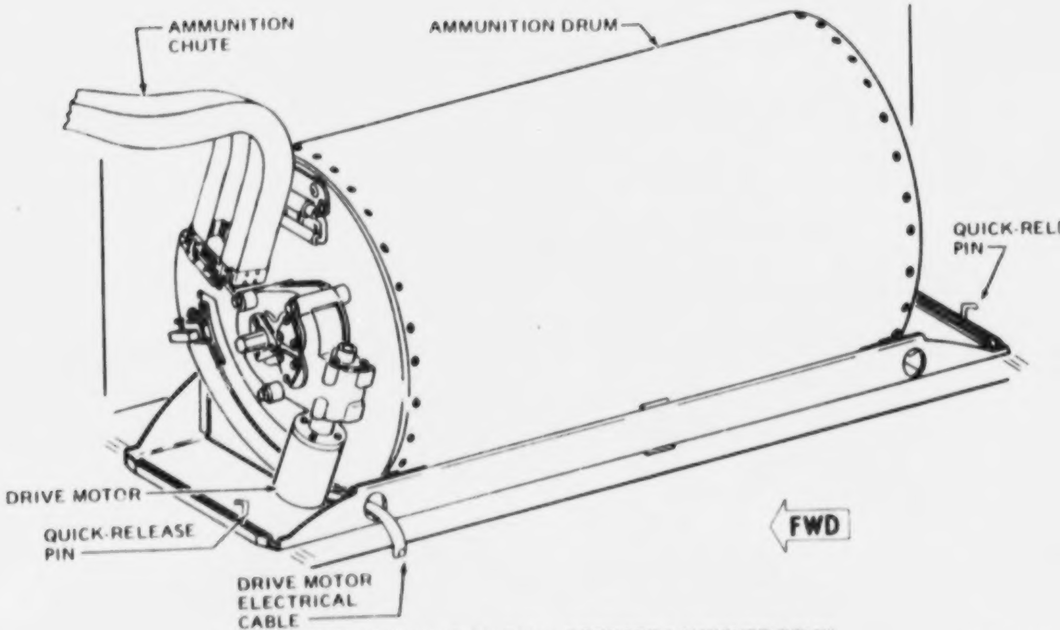
GRENADE LAUNCHER

209071-342B

Figure 4-4. Turret


TORQUE LIMITER
TURRET CIRCUIT BREAKER (2)
FLEXIBLE SHAFT
AMMUNITION DRUM
AMMUNITION CHUTE
QUICK-RELEAS
ROUND COUNTER
ELECTRICAL CABLE PROTECTION TUBE
QUICK-RELEASE PIN
FWD

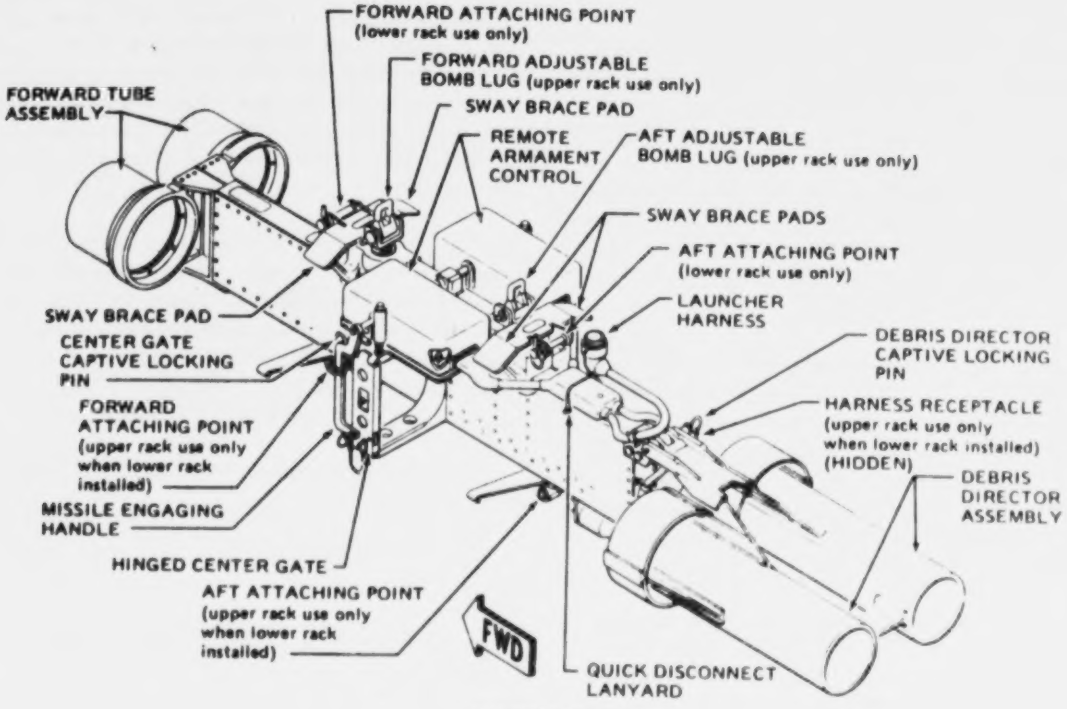
LEFT OR RIGHT AMMUNITION BAY — MACHINE GUN DRUM


AMMUNITION CHUTE
AMMUNITION DRUM
QUICK-REL
PIN
DRIVE MOTOR
QUICK-RELEASE PIN
FWD
DRIVE MOTOR ELECTRICAL CABLE

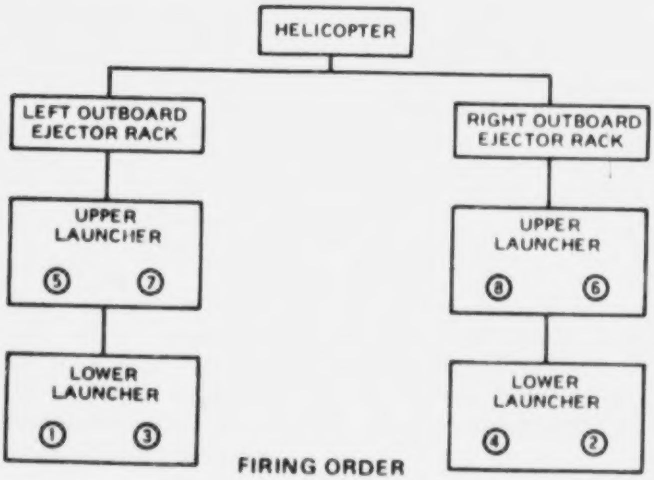
LEFT OR RIGHT AMMUNITION BAY — GRENADE LAUNCHER DRUM

209071-

Figure 4-5. Ammunition drums


FORWARD ATTACHING POINT (lower rack use only)
FORWARD ADJUSTABLE BOMB LUG (upper rack use only)
SWAY BRACE PAD
FORWARD TUBE ASSEMBLY
REMOTE ARMAMENT CONTROL
AFT ADJUSTABLE BOMB LUG (upper rack use only)
SWAY BRACE PADS
AFT ATTACHING POINT (lower rack use only)
LAUNCHER HARNESS
SWAY BRACE PAD
CENTER GATE CAPTIVE LOCKING PIN
DEBRIS DIRECTOR CAPTIVE LOCKING PIN
FORWARD ATTACHING POINT (upper rack use only when lower rack installed)
HARNESS RECEPTACLE (upper rack use only when lower rack installed) (HIDDEN)
DEBRIS DIRECTOR ASSEMBLY
MISSILE ENGAGING HANDLE
HINGED CENTER GATE
AFT ATTACHING POINT (upper rack use only when lower rack installed)
FWD
QUICK DISCONNECT LANYARD

LAUNCHER


HELICOPTER
LEFT OUTBOARD EJECTOR RACK
RIGHT OUTBOARD EJECTOR RACK
UPPER LAUNCHER
⑤ ⑦
UPPER LAUNCHER
⑧ ⑥
LOWER LAUNCHER
① ③
LOWER LAUNCHER
④ ②
209071-343

FIRING ORDER

Figure 4-6. TOW Missile launcher

(figure 4-7) can be mounted on each of the inboard and output ejector racks.

(4) *Wing Gun Pod.* The pod (figure 4-8) is a self-contained unit housing a M134 high rate 7.62 mm machinegun, its own electrical system, battery charging system, and a maximum of 1500 rounds of ammunition. The M18 gun pod is capable of firing 4,000 shots per minute. The M18A1 gun pod has a dual firing rate of 2,000, or 4,000 shots per minute depending on the position of the firing rate switch located at the rear of the pod.

(5) *Smoke Grenade Dispenser.* A dispenser (figure 4-9) (TM 9-1330-208-25) may be attached to each outboard ejector rack or strapped to the rocket launcher on the outboard rack. Each dispenser contains two independently operated racks of six white or color smoke grenades, 12 per dispenser. One to four grenades may drop at one time by the two dispensers.

(6) *Wing Stores Jettison.* Each of the four ejector racks are equipped with an electrically operated ballistic device to jettison the attached weapon during an emergency. Each device has two cartridges. The second cartridge fires automatic if the first fails to fire.

(7). *Helmet Sight Subsystem (HSS).* The HSS (figure 4-10) (TM 9-1270-212-14) permits the pilot or gunner to rapidly acquire visible targets and to direct the turret and/or the telescopic sight unit (TSU) to those targets.

b. *Pilot Switches and Indicators.*

NOTE

Pilot panels and switches are interfaced with other pilot/gunner panels and switches for weapon operations and wing stores jettison. Figure 4-2 shows panel interface. Figure 4-3 shows switch interface.

(1) *Pilot Armament Control Panel.* Refer to figure 4-11.

(2) *Pilot Wing Stores Control Panel.* Refer to figure 4-12.

(3) *Pilot Smoke Grenade Dispenser Control Panel.* Refer to figure 4-13.

(4) *Pilot Smoke Grenade Release Switch.* The switch is on the pilot collective stick switchbox. Pressing the switch will drop one to four grenades and cause a 400-cycle audio tone in the pilot headset. The tone will continue as long as switch is pressed. When the last grenade from the rack is dropped, the tone will continue until the LH/RH ARM switch (figure 4-13) is placed in the OFF position.

(5) *Pilot Wing Stores Jettison Switch.* The guarded switch is on the pilot instrument panel. Activation of the switch will jettison the weapons from the inboard, outboard, or all four of the wing ejector racks. In some situations, jettison will not occur. Refer to figure 4-12 for various jettison and non-jettison combinations.

(6) *Pilot Armament Circuit Breakers.* Refer to figure 4-14.

(7) *Pilot Steering Indicator (PSI).* Refer to figure 4-15.

(8) *Pilot Missile Status Panel (MSP).* Refer to figure 4-16.

(9) *Pilot Gunner Accuracy Control Panel (GACP).* Refer to figure 4-17.

(10) *Pilot Reflex Sight.* Refer to figure 4-18.

(11) *Pilot Helmet Sight.* Refer to figure 4-10.

(12) *Pilot Cyclic Armament Switches.* Refer to figure 2-4.

c. *Gunner Switches and Indicators*

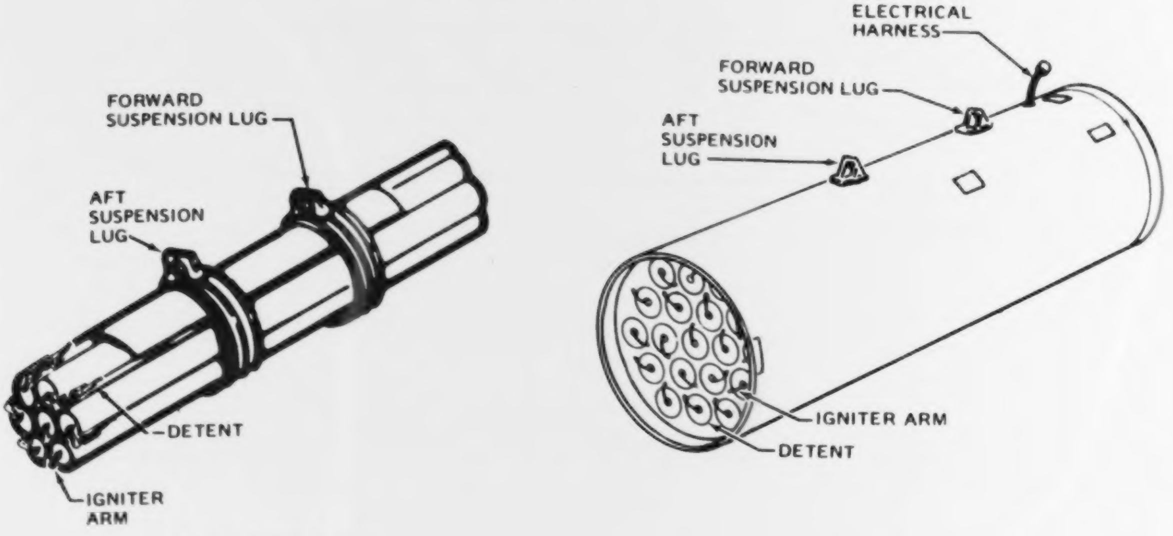
NOTE

Gunner panels and switches are interfaced with other gunner/pilot panels and switches for weapon operations and wing stores jettison. Figure 4-2 shows panel interface. Figure 4-3 shows switch interface.

(1) *Gunner Cyclic Armament Switches.* Refer to figure 2-5.

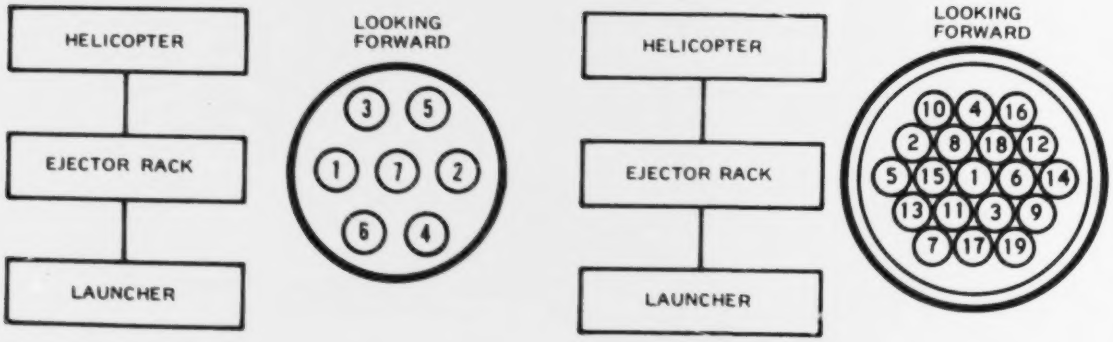
(2) *Gunner Helmet Sight.* Refer to figure 4-10.

(3) *Gunner Telescopic Sight Unit (TSU).* Refer to figure 4-19.


FORWARD SUSPENSION LUG
AFT SUSPENSION LUG
DETENT
IGNITER ARM
ELECTRICAL HARNESS
FORWARD SUSPENSION LUG
AFT SUSPENSION LUG
IGNITER ARM
DETENT

7 TUBE LAUNCHER

19 TUBE LAUNCHER

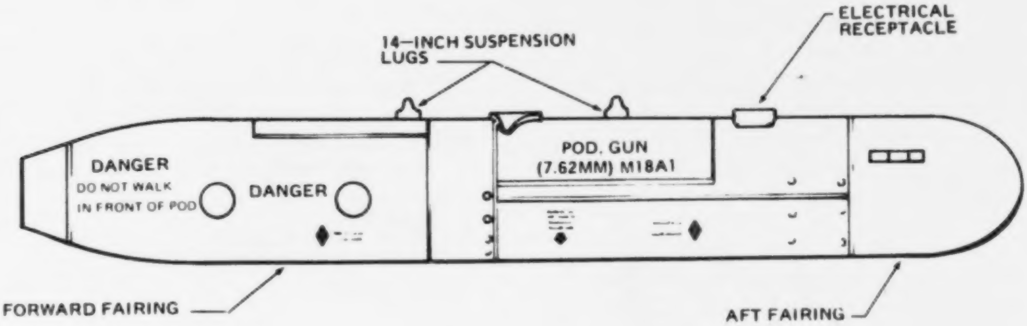

HELICOPTER
EJECTOR RACK
LAUNCHER
LOOKING FORWARD
3
5
1
7
2
6
4
HELICOPTER
EJECTOR RACK
LAUNCHER
LOOKING FORWARD
10
4
16
2
8
18
12
5
15
1
6
14
13
11
3
9
7
17
19

7 TUBE LAUNCHER FIRING ORDER

19 TUBE LAUNCHER FIRING ORDER

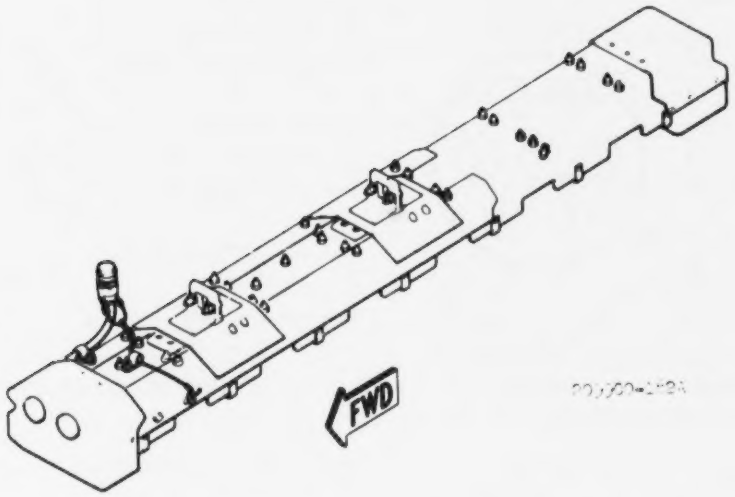
209071-355B

Figure 4-7. Folding fin aerial rocket (2.75 inch) launcher


14—INCH SUSPENSION LUGS
ELECTRICAL RECEPTACLE
DANGER
DO NOT WALK IN FRONT OF POD
DANGER
POD. GUN (7.62MM) M18A1
FORWARD FAIRING
AFT FAIRING

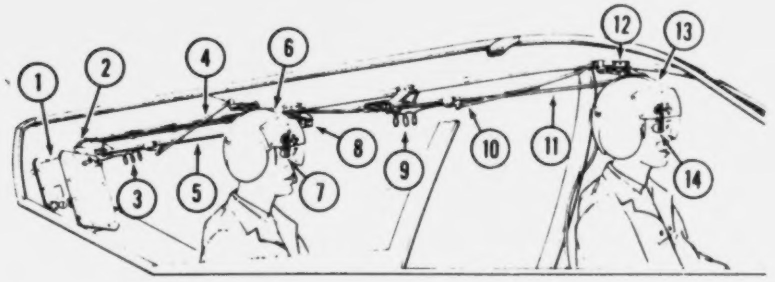
209900-183B

Figure 4-8. Wing gun pod

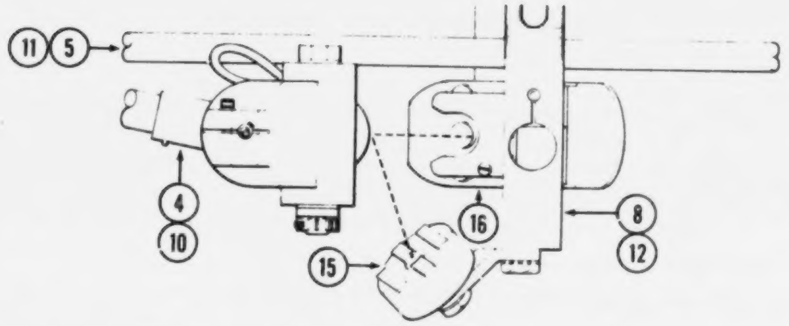


209900-182A

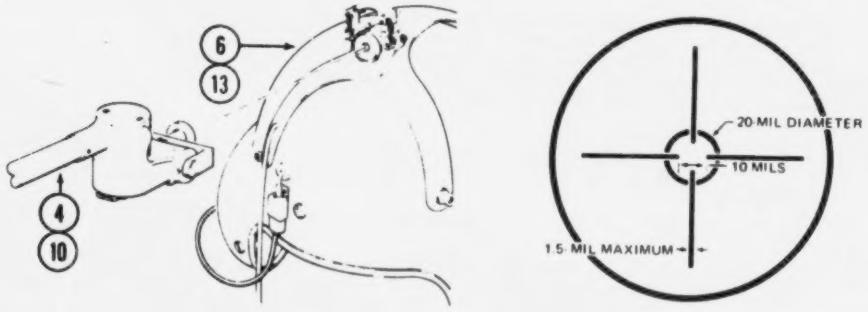
Figure 4-9. Smoke grenade dispenser


1
2
4
6
12
13
3
5
7
8
9
10
11
14

HELMET SIGHT SUBSYSTEM


11
5
4
10
16
8
12
15

PILOT/GUNNER LINKAGE ARM ATTACHMENT TO BIT MAGNET AND STOW BRACKET


6
13
4
10
20-MIL DIAMETER
10 MILS
1.5-MIL MAXIMUM

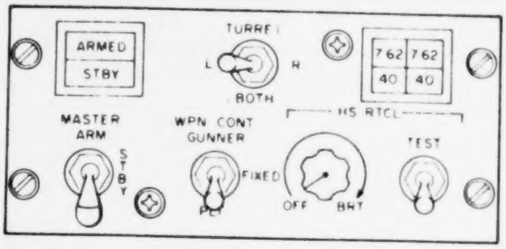
PILOT/GUNNER LINKAGE ARM ATTACHMENT TO HELMET SIGHT

PILOT/GUNNER EYEPIECE RETICLE PATTERN

1. Electronic Interface Assembly
2. Gunner Extension Cable
3. Pilot Linkage Cable
4. Pilot Linkage Arm
5. Pilot Linkage Rails
6. Pilot Helmet Sight
7. Pilot Eyepiece
8. Pilot Linkage Front Support
9. Gunner Linkage Cable
10. Gunner Linkage Arm
11. Gunner Linkage Rails
12. Gunner Linkage Front Support
13. Gunner Helmet Sight
14. Gunner Eyepiece
15. BIT Magnet
16. Stow Bracket

209071-344

Figure 4-10. Helmet sight subsystem (HSS)

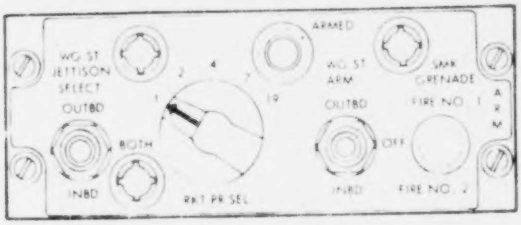


LOCATION: PILOT INSTRUMENT PANEL

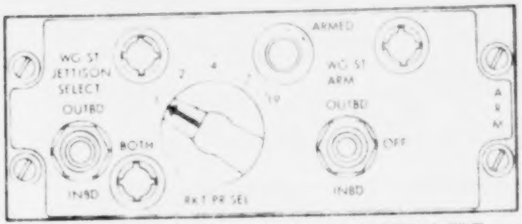
ITEM	FUNCTION	
MASTER ARM Switch	Off	— Deactivates all sights and weapon control/firing circuits.
	STBY	— Activates all sights, turret and TOW missile control circuits, and smoke grenade firing circuits. Charges wing gun pod battery.
	ARM	— Activates all sights and weapon control/firing circuits. Charges wing gun pod battery.
	Warning	— MASTER ARM switch bypassed when gunner PLT OVRD switch in OVRD.
WPN CONT Switch	PLT	— Permits pilot to fire turret using HS and wing stores (not TOW) using reflex sight.
	FIXED	— Permits pilot to fire turret and wing stores (not TOW) using reflex sight.
	GUNNER	— Permits gunner to fire turret using helmet sight or TSU and TOW using TSU.
TURRET Switch	L	— Permits pilot to fire turret left weapon (grenade launcher) (except TOW).
	R	— Permits pilot to fire turret right weapon (machine gun).
	BOTH	— Permits pilot to fire turret right weapon (machine gun).
	Note	— Previously, BOTH position permitted firing both weapons if same type or machine gun if different types. This was due to multiple configurations.
HS RTCL OFF/BRT Swit	OFF	— Deactivates pilot HS reticle lamps.
	Turn	— Varies intensity of pilot HS reticle lamps.
HS RTCL TEST Switch	TEST	— Test pilot HS reticle.
ARMED/STBY Indicato	ARMED	— Indicates MASTER ARM switch in ARM (amber light) or pilot override.
	STBY	— Indicates MASTER ARM switch in STBY (green light).
	Off	— Indicatees MASTER ARM switch is off.
	Press	— Tests indicator lights.
7.62/7.62/40/40 Indicators	Right 7.62	— Indicates machine gun in right side of turret.
	Left 40	— Indicates grenade launcher in left side of turret.
	Left 7.62	— Inoperative.
	Right 40	— Inoperative.
	Press	— Tests indicator lights.
	Off	— Indicates pilot does not have control of the turret.
	Note	— Left 7.62/right 40 inoperative due to standard configuration.

209075-295B

Figure 4-11. Pilot armament control panel


WG ST
JETTISON
SELECT
OUTBD
BOTH
INBD
1
2
4
7
19
RKT PR SEL
ARMED
WG ST
ARM
OUTBD
OFF
INBD
SMK
GRENADE
FIRE NO. 1
FIRE NO. 2
A
R
M

HELICOPTERS S/N 68-15052 AND PRIOR


WG ST
JETTISON
SELECT
OUTBD
BOTH
INBD
1
2
4
7
19
RKT PR SEL
ARMED
WG ST
ARM
OUTBD
OFF
INBD
A
R
M

HELICOPTERS S/N 68-15053 AND SUBSEQUENT

LOCATION: PILOT INSTRUMENT PANEL

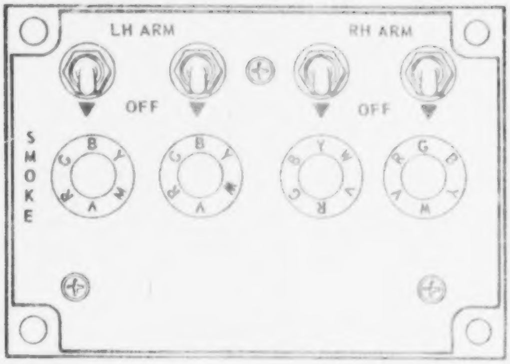
ITEM	FUNCTION
WG ST ARM Switch	OFF — Deactivates rocket and wing gun pod circuits. INBD — Permits pilot to fire rockets/gun pods mounted on wing inboard ejector racks. OUTBD — Permits pilot to fire rockets mounted on wing outboard ejector racks.
ARMED Indicator	OFF — Indicates WT ST ARM switch is in the OFF position. ON — Indicates WT ST ARM switch is in the INBD or OUTBD position. Turn — Varies intensity of indicator light.
RKT PR SEL Switch	Turn — Selects quantity of rocket pairs for firing.
WG ST JETTISON SELECT Switch	Functions — As follows when the pilot WING STORES JETTISON switch is in the ON position:

WG ST JETTISON SELECT SWITCH	CIRCUIT BREAKER		JETTISON
	DC WING STORES JETTISON	ELECTRICAL COMPARTMENT JETTISON	
INBD	In	In	Inboard
	In	Out	Inboard
	Out	In	Both
	Out	Out	None
OUTBD	In	In	Outboard
	In	Out	Outboard
	Out	In	Both
	Out	Out	None
BOTH	In	In	Both
	In	Out	None
	Out	In	Both
	Out	Out	None

NOTE: In the 4 TOW configuration when the WG ST JETTISON SELECT switch is in the INBD position, the outboard stores jettison first.

209057-290

Figure 4-12. Pilot wing stores control panel

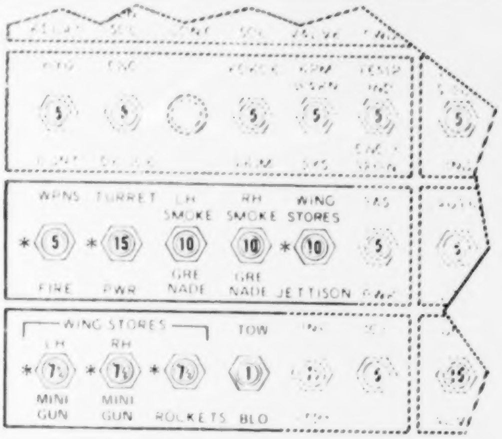


LOCATION: PILOT LEFT BULKHEAD
EFFECTIVITY: HELICOPTER 68-15000 AND SUBSEQUENT

ITEM	FUNCTION
• LH ARM Switches	OFF — Deactivates left wing smoke grenade circuit. LH ARM — Permit pilot to fire left wing smoke grenades.
• RH ARM Switches	OFF — Deactivates right wing smoke grenade circuit. RH ARM — Permit pilot to fire right wing smoke grenades.
• Color Indicators	B, Y, W, V, R, G — Indicates color of grenades installed. B — Blue Y — Yellow W — White V — Violet R — Red G — Green
• One for each rack of each dispenser (total of two per dispenser)	

209075-291A

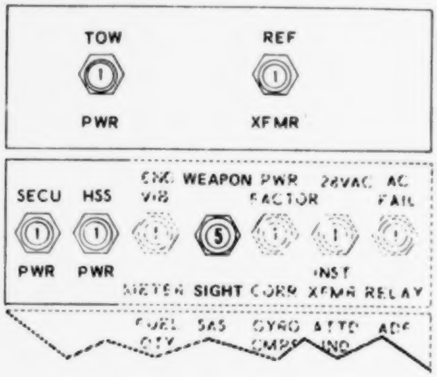
Figure 4-13. Pilot smoke grenade dispenser control panel


WPNS
TURRET
LH SMOKE
RH SMOKE
WING STORES
SAS
*5
*15
10
10
*10
5
FIRE
PWR
GRE NADE
GRE NADE
JETTISON
WING STORES
LH
RH
TOW
*7½
*7½
*7½
1
5
15
MINI GUN
MINI GUN
ROCKETS
BLO

PILOT DC CIRCUIT BREAKER PANEL
LOCATION: PILOT RIGHT CONSOLE

NOTE

Armament circuit breakers indicated by asterisk may be toggle or push-pull type.

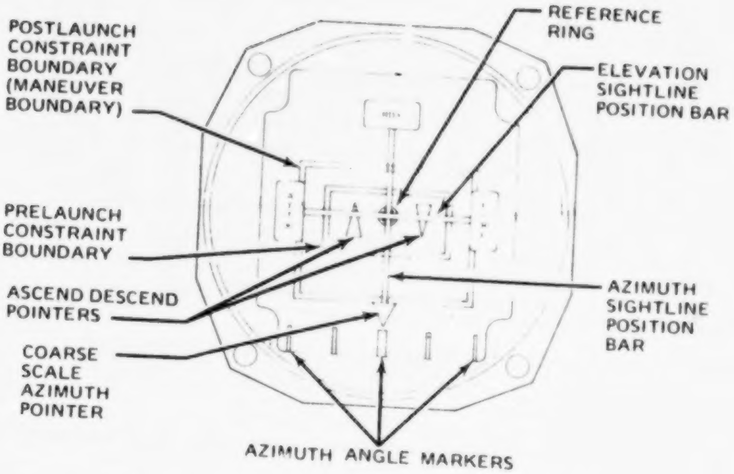

TOW
REF
1
1
PWR
XFMR
SECU
HSS
ENG VIB
WEAPON
PWR FACTOR
28VAC
AC FAIL
1
1
5
1
PWR
PWR
METER
SIGHT
CORR
INST XFMR
RELAY
FUEL QTY
SAS
GYRO CMPS
ATTD IND
ADF

PILOT AC CIRCUIT BREAKER PANEL
LOCATION: PILOT LEFT CONSOLE

CIRCUIT BREAKER	FUNCTION — APPLIES POWER TO AND PROTECTS CIRCUITS FOR
DC	
WPNS FIRE	Turret firing.
TURRET PWR	Turret control.
LH SMOKE GRENADE	Left outboard smoke grenade drop.
RH SMOKE GRENADE	Right outboard smoke grenade drop.
WING STORES JETTISON	Jettison — Refer to pilot wing stores control panel figure.
WING STORES LH MINI-GUN	Left inboard wing gun pod firing.
WING STORES RH MINI-GUN	Right inboard wing gun pod firing.
WING STORES ROCKETS	Left/right inboard/outboard rocket firing.
TOW BLO	Blower to cool tailboom equipment.
AC	
TOW PWR	TOW missile firing.
REF XFMR	Electronic interface assembly boresight.
SECU PWR	Servo electronic control unit.
HSS PWR	Helmet sight subsystem.
WEAPON SIGHT	Telescopic sight unit, turret hydraulic, and pilot reflex sight.

209075-292C

Figure 4-14. Pilot armament circuit breakers

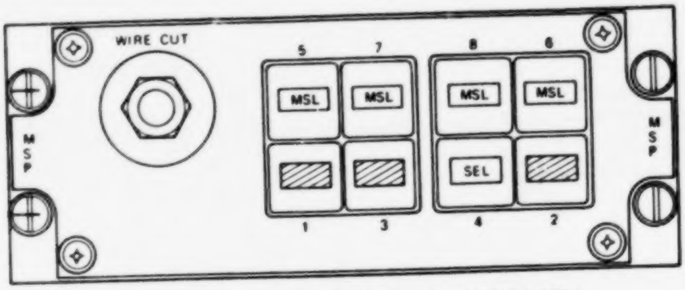

POSTLAUNCH CONSTRAINT BOUNDARY (MANEUVER BOUNDARY)
PRELAUNCH CONSTRAINT BOUNDARY
ASCEND DESCEND POINTERS
COARSE SCALE AZIMUTH POINTER
REFERENCE RING
ELEVATION SIGHTLINE POSITION BAR
AZIMUTH SIGHTLINE POSITION BAR
AZIMUTH ANGLE MARKERS

LOCATION: TOP OF PILOT INSTRUMENT PANEL

ITEM	FUNCTION
ATTK Annunciator	ON — Indicates TCP MODE SELECT switch is in ARMED position. All requirements for firing have been met, except pre-launch constraint
RDY Annunciator	ON — Indicates pilot has achieved prelaunch constraints.
FIRE Annunciator	ON — Indicates trigger has been pulled and firing sequence started
Reference Ring (Fixed)	— Represents helicopter reference axis.
Prelaunch Constraint Boundary (Fixed)	— Represents boundary within which the pilot must keep the sightline position bars prior to and during TOW launch. The boundary represents ±2.5° aximuth and ±6° elevation.
Postlaunch Constraint Boundary (Fixed)	— Represents boundary within which the pilot must keep the sightline position bars after TOW launch and until wire cut or missile impact ±110° YAW, -30 to 60° PITCH, ±30° ROLL.
Elevation/ Azimuth Sightline Position Bars (Moveable)	— Indicate elevation and azimuth of TSU gimbal angles with respect to helicopter reference axis (reference ring) and constraint boundaries.
Ascend Descend Pointers (Indicator)	ON — Indicates helicopter requires a nose-up or nose-down attitude to reduce the line-of-sight rate during prelaunch stage. OFF — Indicates helicopter nose-up and nose-down attitudes and line-of-sight rate are compatible.
Azimuth Angle Markers (Fixed)	— Represents TSU ± 110° azimuth limits.
Course Scale Azimuth Pointer (Moveable)	— Indicates azimuth of TSU gimbal angles on the azimuth angle markers.

209071-345D

Figure 4-15. Pilot steering indicator (PSI)



LOCATION: PILOT INSTRUMENT PANEL

ITEM	FUNCTION	
WIRE CUT Switch	Press	— Permits pilot to manual cut missile command wire.
MSL/SEL/ Barberpole Missile States Indicators	MSL	— Indicates missile is present in a specific location of launcher.
	SEL	— Indicates missile is present in a specific location of launcher and selected for firing.
	Barberpole	— Indicates missile is not present in a specific location of launcher.

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Figure 4-16. Pilot missile status panel (MSP)

NOTE

The light shield on the telescopic sight unit headrest is not compatible with standard eyeglasses.

(4) *Gunner Armament Control Panel.* Refer to figure 4-20.

(5) *Gunner Wing Stores Jettison Switch.* The guarded switch is on the gunner instrument panel. Activation of the switch will jettison all weapons from all ejector racks. The switch is powered and protected by the jettison circuit breakers in the electrical compartment.

(6) *Gunner Sight Hand Control (SHC).* Refer to figure 4-21.

(7) *Gunner TOW Control Panel (TCP).* Refer to figure 4-22.

(8) *Gunner Camera.* The motion picture camera (figure 4-19) is designed for use with standard 16mm black and white or color film. An expendable, subdued-light loading, 50-foot film cartridge is supplied.

(a) The camera will operate at speeds of 16, 22, 32, and 64 frames per second. The selection of camera speed is made manually before takeoff by setting the speed control knob on the lower right side of the camera.

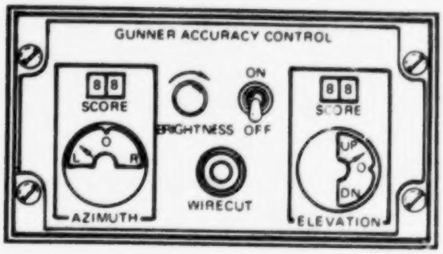
(b) Proper functioning of the camera exposure control switch on the TOW control panel (figure 4-22) requires presetting of the diaphragm control ring to the proper F-stop marking on the lens barrel as follows:

Frame Speed -	16	32	64
Lens Setting (Day) -	f/5.6	f/4	f/2.8
Lens Setting (Night) -	f/2.8	f/2.8	f/2.8

4-4. Preflight Procedures.

WARNING

The machine gun in the turret and wing gun pods will fire when rotated by hand or otherwise. The grenade launcher in the turret will fire when the barrel is pushed in.

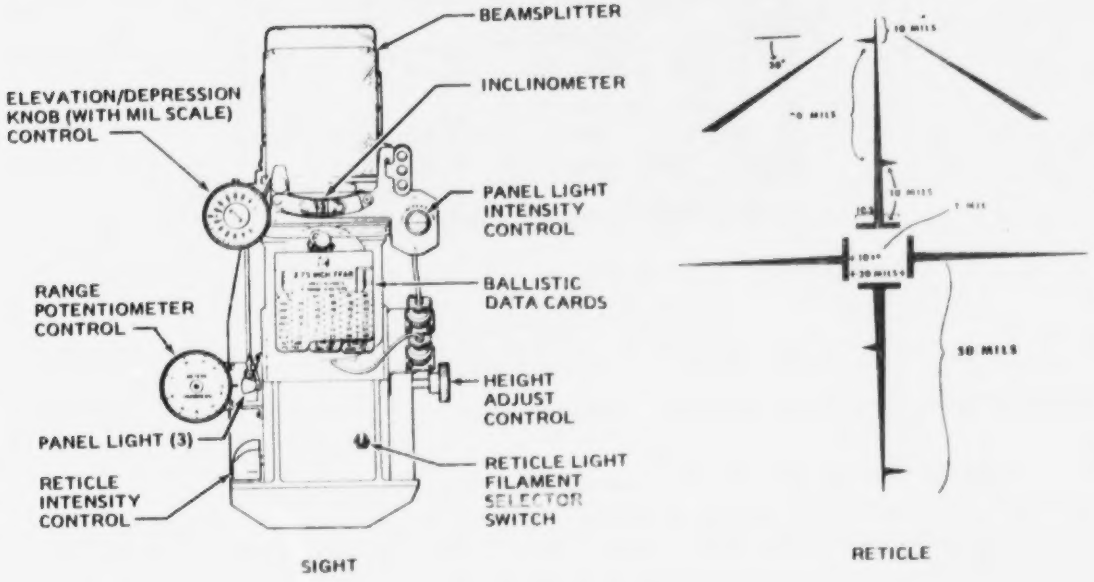

GUNNER ACCURACY CONTROL
88
SCORE
L
O
R
AZIMUTH
BRIGHTNESS
ON
OFF
WIRECUT
88
SCORE
UP
O
DN
ELEVATION

LOCATION: PILOT INSTRUMENT PANEL
NOTE: INSTALL IN LIEU OF PILOT MISSILE STATUS PANEL DURING TRAINING TO EVALUATE GUNNER TOW TRACKING ABILITY

ITEM	FUNCTION
ON/OFF Switch	ON — Activates gunner accuracy control circuits. — Performs built-in-test of circuits. Circuits pass test if AZIMUTH/ELEVATION SCORE indicators display 55 ± 5. OFF — Deactivates circuits.
WIRE CUT Switch	Press— Resets indicators and deactivates camera.
AZIMUTH Indicator	— Displays TSU azimuth line-of-sight.
AZIMUTH SCORE Indicator	— Displays gunner final azimuth score.
ELEVATION Indicator	— Displays TSU elevation line-of-sight.
ELEVATION SCORE Indicator	— Displays gunner final elevation score.
BRIGHTNESS Knob	Turn — Varies intensity of AZIMUTH/ELEVATION SCORE indicator lights.

209071-347A

Figure 4-17. Pilot gunner accuracy control panel (GACP)


BEAMSPLITTER
INCLINOMETER
ELEVATION/DEPRESSION KNOB (WITH MIL SCALE) CONTROL
PANEL LIGHT INTENSITY CONTROL
RANGE POTENTIOMETER CONTROL
BALLISTIC DATA CARDS
HEIGHT ADJUST CONTROL
PANEL LIGHT (3)
RETICLE INTENSITY CONTROL
RETICLE LIGHT FILAMENT SELECTOR SWITCH
10 MILS
30°
10 MILS
10°
20 MILS
30 MILS

SIGHT

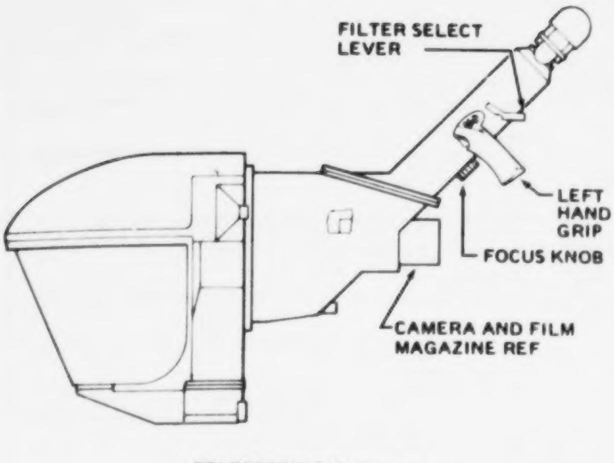
RETICLE

LOCATION: TOP OF PILOT INSTRUMENT PANEL

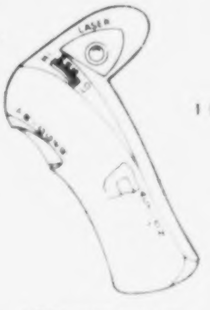
ITEM	FUNCTION	
Elevation/Depression Control	Turn	— Varies angle of beamsplitter to adjust for range and airspeed when firing wing stores (not TOW) per the ballistic data cards.
Range Potentiometer Control	Turn	— Applies correctional elevation signal to turret.
Height Adjust Control	Turn	— Raises upper portion of sight.
Reticle Intensity Control	Turn	— Adjust intensity of reticle lights.
Reticle Light Filament Selector Switch	Down/Up	— Selects one of two filaments of reticle light.
Panel Light Intensity Control	Turn	— Adjust intensity of panel lights.
Inclinometer		— Indicates helicopter yaw attitude.

209071-348

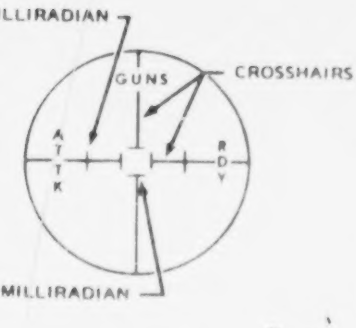
Figure 4-18. Pilot reflex sight



TELESCOPIC SIGHT UNIT
LOCATION: GUNNER STATION



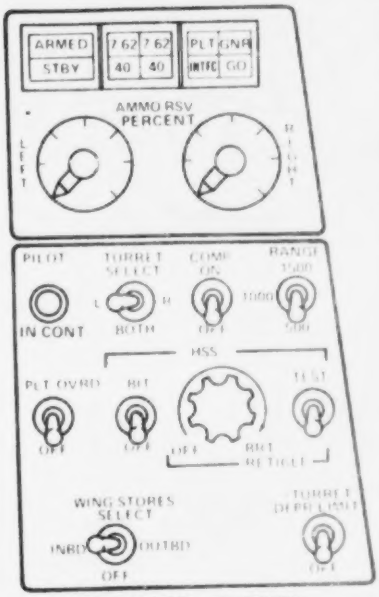
LEFT HAND GRIP



VIEW OF RETICLE

ITEM	FUNCTION	
Left Hand Grip Switches MAG Switch	LO	— Magnifies target two times
	HI	— Magnifies target 13 times.
TRIGGER Switch	Press	— Fires TOW or 40 mm if selected in first or second detent.
		— Fires turret at low rate (2000 rounds per minute) in first detent.
		— Fires turret at high rate (4000 rounds per minute) in second detent.
ACTION Switch	Press	— Activates TOW launchers.
		— Slaves turret to TSU or gunner helmet sight.
LASER Switch		— Inoperative.
TSU Reticle GUNS Indicator	Flash	— Indicates TCP MODE SELECT switch is in TSU/GUN position and turret not aligned with TSU.
	Steady	— Indicates TCP MODE SELECT switch is in TSU/GUN position and turret is aligned with TSU.
ATTK Indicator	ON	— Indicates TCP MODE SELECT switch is in ARMED position. All requirements have been met except prelaunch constraints.
RDY Indicator	ON	— Indicates pilot has achieved prelaunch constraints for TOW firing.
Filter Select Lever	Move	— Select filters of different light intensities.
	Red	— Use when firing a TOW missile to reduce glare from the IR source on missile and thus allow proper tracking of the target.
	Clear	— To be used during low light level conditions, such as hazy (smoke, fog, dust) days or under twilight conditions.
	Natural Density	— To be used on bright clear days or to reduce the glare reflected from bodies of water.
	Laser Filter	— To be used during any laser operations to protect the eyes from laser radiation energy.
Focus Knob	Turn	— Focus the target image.

Figure 4-19. Gunner telescopic sight unit (TSU)


ARMED
STBY
7.62
7.62
40
40
PLT
GNR
INTFC
GO
AMMO RSV PERCENT
LEFT
RIGHT
PILOT
IN CONT
TURRET SELECT
L
R
BOTH
COMP ON
OFF
RANGE
1500
1000
500
HSS
PLT OVRD
OFF
BIT
OFF
TEST
OFF
BRT
RETICLE
WING STORES SELECT
INBD
OUTBD
OFF
TURRET DEPR LIMIT
OFF

LOCATION: GUNNER RIGHT CONSOLE

ITEM	FUNCTION	
TURRET DEPR LIMIT Switch	OFF	— Permits turret travel minimum to maximum elevation.
	DEPR LIMIT	— Limits downward travel to prevent turret weapons from striking ground.
WING STORES SELECT Switch	OFF	— Deactivates wing stores (not TOW) circuits.
	INBD/ OUTBD	— Permits gunner to fire inboard/outboard wing stores.
	Note	— Funtions only when PLT OVRD switch n OVRD.
PLT OVRD Switch	OFF	— Permits pilot armament control panel to control the weapons.
	PLT OVRD	— Overrides pilot armament conrol panel. Permits gunner to fire turret using HS and wing stores (not TOW or smoke) without sight.
HSS BIT Switch	OFF	— Deactivates pilot and gunner HSS built-in test circuit.
	BIT	— Tests pilot and gunner HSS when linkage arms attached to BIT magnets.
HSS RETICLE OFF/BRT Switch	OFF	— Deactivates gunner HS reticle lights.
	TURN	— Varies intensity of gunner HS reticle lights.
HSS RETICLE TEST Switch	TEST	— Tests gunner HS reticle.
RANGE Switch	500/ 100/ 1500	— Provides meters to target data to compensation circuit.
COMP Switch	OFF	— Deactivates turret poisitioning circuits.
	ON	— Applies airspeed/range data to turret positioning circuits.
TURRET SELECT Switch	L	— Permits gunner to fire turret left weapon.
	R	— Permits gunner to fire turret right weapon.
	BOTH	— Permits gunner to fire turret right weapon.
	NOTE	— Permits gunner to fire both weapons if same i.e., Two machine guns or two grenade launchers.
PILOT IN CONT Indicator	ON	— Pilot has control of turret.
	OFF	— Gunner has control of turret or pilot MASTER ARM switch is OFF.

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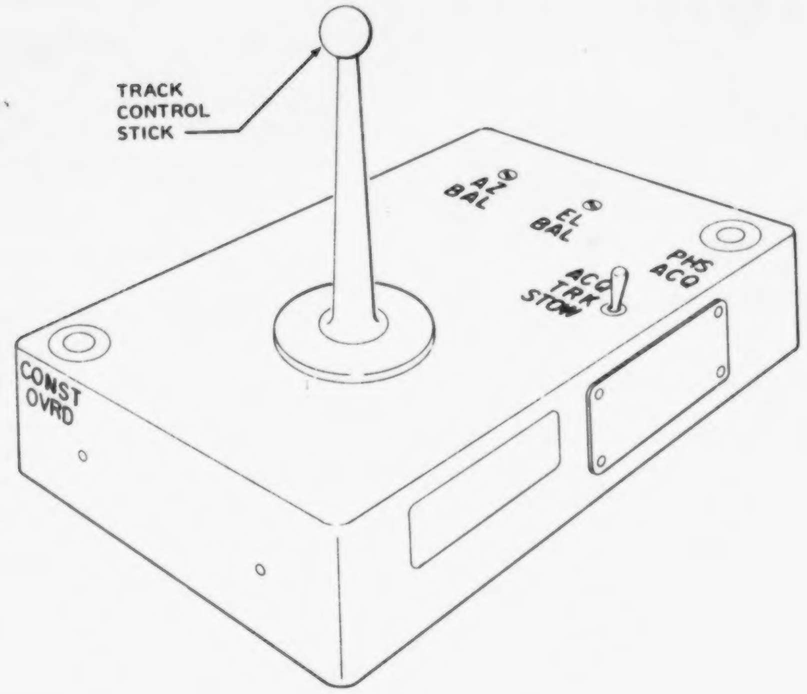
Figure 4-20. Gunner armament control panel (Sheet 1 of 2)

ITEM	FUNCTION	
AMMO RSV PERCENT	Gradations	— Indicates percentage of ammunition remaining for each turret weapon.
Indicators	RESET	— Permits pointers to be positioned to reflect initial percentage.
PLT/ GNR/ INTFC/ GO Indicators	PLT	— Indicates failure in pilot HSS.
	GNR	— Indicats failure in gunner HSS.
	INTFC	— Indicates failure in electronic interface assembly.
	GO	— Indicates HSS operating properly.
	Press	— Tests indicator lights.
	Off	— Indicates HSS built-in-test not being conducted.
7.62/ 7.62./ 40/40 Indicators	Right 7.62	— Indicates machine gun in right side of turret.
	Left 40	— Indicates grenade launcher in left side of turret.
	Left 7.62	— Inoperative.
	Right 40	— Inoperative.
	Press	— Tests ndicator lights.
	Off	— Indicates gunner does not have control of turret.
	Note	— Left 7.62 and right 40 inoperative due to standard configuration.
ARMED/ STBY Indicator	ARMED	— Indicats pilot MASTER ARM switch in ARM (amber light).
	STBY	— Indicates pilot MASTER ARM switch in STBY (green light).
	Off	— Indicates pilot MASTER ARM switch is off.
	Press	— Tests indicator lights.

209075-293-2B

Figure 4-20. Gunner armament control panel (Sheet 2 of 2)

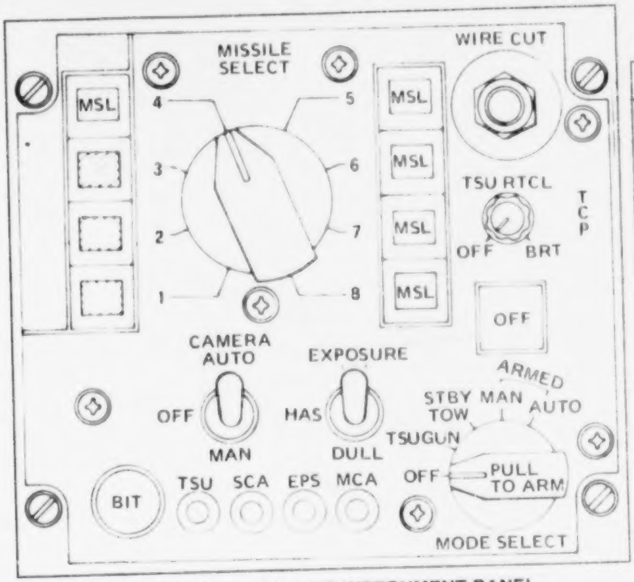


LOCATION: GUNNER INSTRUMENT PANEL

ITEM	FUNCTION	
Track Control Stick	Move	— Positions TSU in azimuth and elevation.
ACQ/TRK/STOW Switch	ACQ	— Slaves TSU to gunner HS for target acquisition.
	TRK	— Permits track control handle to position TSU.
	STOW	— Stows TSU dead-ahead.
PHS ACQ Switch	Press	— Slaves TSU to pilot HS when mode switch is in track.
EL BAL Screw		— Used during maintenance.
AZ BAL Screw		— Used during maintenance.
CONST OVRD Switch	Press	— Permits TOW firing when helicopter is not aligned within pre-launch constraints

209071-350D

Figure 4-21. Gunner sight hand control (SHC)



LOCATION: **GUNNER INSTRUMENT PANEL**

ITEM	FUNCTION		
MODE SELECT Switch	OFF	—	Deactivates TSU and TMS circuits.
	TSU/GUN	—	Selects turret operation for gunner.
	STBY TOW	—	Permits gunner to control TMS.
	MAN	—	Permits gunner to select missile to be fired manually.
	AUTO	—	Missile to be fired is automatically selected.

ITEM	FUNCTION		
TSU/SCA/ EPS/MCA Unit Fail Indicators	Black Flag	—	Indicates unit operational during performance or built-in-test.
	White Flag	—	Indicates unit failure during performance or built-in-test.
	Note	—	EPS indicates failure during performance, built-in-test, or nonperformance.
BIT Switch	Press	—	Initiate manual BIT test by pressing and releasing, if held all flags will appear
CAMERA Switch	OFF	—	Deactivates camera circuit.
	MAN	—	Permits continuously operation of camera.
	AUTO	—	Permits operation of camera when LHG TRIGGER is pressed.
EXPOSURE Switch	BRT	—	Permits camera to adapt to bright conditions.
	HAZ	—	Permits camera to adapt to hazey conditions.
	DUL	—	Permits camera to adapt to dull conditions.
OFF/PWR ON/ ARMED/TEST System Status Annunciator	OFF	—	Indicates MODE SELECT switch is OFF.
	PWR ON	—	Indicates MODE SELECT switch is in the STBY TOW position or TSU GUN
	ARMED	—	Indicates MODE SELECT switch is in the ARMED position.
	TEST	—	Indicates built-in-test is being performed.
TSU RTCL Switch	OFF	—	Deactivates the TSU reticle circuit.
	Turn	—	Varies intensity of TSU reticle lights.
WIRE CUT Switch	PRESS	—	Permits gunner to manually cut missile command wire.
MSL/Barberpole Missile Status Indicators	MSL	—	Indicates missile is present in a specific location of launcher.
	Barberpole	—	Indicates missile is not present in a specific location of launcher.
MISSILE SELECT Switch	1/2/3/4/ 5/6/7/8	—	Indicates missile selected (manual or automatic) for firing.

Figure 4-22. Gunner TOW control panel (TCP)

NOTE

Checks herein are only applicable if the armament is installed. Checks herein are in addition to those listed in Chapter 8. Chapter 4 does not duplicate Chapter 8 except for safety checks.

4-5. BEFORE EXTERIOR CHECK — ALL ARMAMENT — PREFLIGHT.

1. Wing ejector racks — Jettison safety pins installed.
2. TOW launcher — Missile engaging handle up.
3. Rocket launcher — Igniter arms in contact with rockets.
4. MASTER ARM switch — OFF.
5. PLT OVRD switch — OFF.

4-6. EXTERIOR CHECK — TURRET — PREFLIGHT.

a. Turret Right Side — Machine Gun.

1. Bullet trap — Installed.
2. Access door — Open/remove.
3. Barrel clamp and retaining bolt — Secure.
4. Gun Mounting — Quick-release pins (ring up) installed through gun saddle outboard holes and recoil adapters, recoil adapters secure on gun, gun support extension over saddle azimuth boresight support.
5. Link ejection chute — Condition and security.
6. Ammunition chute — Condition and security.
7. Cartridge ejection chute — Condition and security.
8. Delinking feeder — Condition and security.
9. Gate solenoid — Plunger returns to extended position when pressed, electrical connectors condition and security.
10. Gun drive — Flexible shaft and electrical connectors condition and security.
11. Gun timing pin — Set.
12. Delinking feeder timing — Set.
13. Hydraulic lines — Condition and security.
14. Access door — Close/replace and secure.
15. Telescopic sight unit — Rotate TSU 90 degrees. Check covers removed and windows clean.

b. Ammunition Bay Right Side — Machine Gun.

1. Bay door — Open.
2. Ammunition drum — Condition and secure with quick-release pins.
3. Flexible shaft — Condition and secure to torque limiter.
4. Round counter — Condition and electrical cable connected.
5. Ammunition chute — Condition, security, and ammunication present.
6. Turret circuit breakers — In.
7. Hydraulic/electrical lines — Condition and security.
8. Bay door — Close and secure.

c. Turret Left Side — Grenade Launcher.

1. Access door — Open/remove.
2. Gun cradle mounting — Quick-release pins (ring up) installed through gun saddle inboard holes and recoil adapters, recoil adapters secure on cradle, cradle rear bushing over saddle azimuth boresight support.

3. Launcher mounting — Launcher front support rollers in gun cradle fords, launcher rear secure to cradle with bolts.

4. Ammunition chute/feed tray — Condition, security, and ammunition present.

5. Ejection chute — Condition and security.

6. Gun drive — Flexible shaft and electrical connectors condition and security.

7. Hydraulic lines — Condition and security.

8. Access door — Close/replace and secure.

d. Ammunition Bay Left Side — Grenade Launcher.

1. Bay door — Open.

2. Ammunition drum — Condition and secure with quick-release pins.

3. Drive motor — Condition, security, and electrical cable connected.

4. Round counter — Condition and electrical cable connected.

5. Ammunition chute — Condition, security, and ammunition present.

6. Hydraulic/electrical lines — Condition and security.

7. Bay door — Close and secure.

e. Machine gun bullet trap — Remove.

4-7. EXTERIOR CHECK — TOW — PREFLIGHT.

1. Launcher Mounting — Upper launcher aft and forward adjustable bomb lugs secure to helicopter ejector racks and rack swaybrace bolts firmly against launcher swaybrace pads. Lower launcher aft and forward attaching points secure to upper launcher aft and forward attaching points.

2. Electrical connector — Upper launcher harness connected to helicopter receptacle and jettison quick disconnect lanyard attached to harness and launcher. Quick disconnect lanyard not twisted. Lower launcher harness connected to upper launcher harness receptacle.

3. Missile Installation — Missile front ring seated in forward tube mating ring, hinged center gate and debris director secure with captive locking pins. Note number of and position of installed missiles (needed for interior check).

4-8. EXTERIOR CHECK — ROCKET LAUNCHER — PREFLIGHT.

1. Launcher Mounting — Launcher aft and forward bomb suspension lugs secure to helicopter ejector racks. Rack swaybrace bolts firmly against launcher but not denting exterior.

2. Electrical connection — Harness connected to launcher and helicopter receptacles. Jettison quick disconnect lanyard attached to harness and launcher.

3. Launcher — Launcher exterior and tube interiors for damage and corrosion.

4. Rocket installation — Rocket aft end secure in launcher tube aft detent.

5. Igniter arms — Damage and corrosion.

4-9. EXTERIOR CHECK — WING GUN POD - PREFLIGHT.

1. Front fairing — Removed.

2. Bullet trap — Installed.

3. Pod mounting — Pod front and rear lugs secure to helicopter ejector racks. Rack swaybrace bolts firmly against pod but not denting exterior.

4. Electrical connection — Harness connected to pod and helicopter receptacles. Jettison quick disconnect lanyard attached to harness and pod.

5. Pod — Pod exterior for condition (includes front fairing removed during Before Exterior Check).

6. Gun barrel clamp and retaining bolt — Secure.

7. Gun mounting — Recoil adapters, quick release pins, and rear mount secure.

8. Gun gate solenoid — Plunger returns to extended position when pressed, electrical connectors condition and security.

9. Gun exit unit — Condition and security.

10. Gun feeder wheel — Condition and security.

11. Gun electrical drive — Drive and electrical connectors condition and security.

12. Gun safing sector — Secure.

13. Gun round counters (2) — Set.

14. Gun timing pin — Set.

15. Gun feeding timing pin — Set.

16. Gun exit unit timing pin — Set.

17. Rear fairing — Remove.

18. Battery switch — CHARGE.

19. Heater switch — As desired.

20. High/low rate firing switch — As desired (if equipped).

21. Aircraft field switch — As desired (if equipped).

22. Battery — Damage, leaking cells, and corrosion.

23. Rear fairing — Replace and secure.

24. Bullet trap — Remove.

25. Front fairing — Replace and secure.

4-10. EXTERIOR CHECK — SMOKE GRENADE DISPENSER — PREFLIGHT.

1. Dispenser Mounting — On ejector rack, dispenser front and rear mounting lugs secure to helicopter ejector rack and rack swaybrace bolts firmly against dispenser but not denting exterior. On rocket launcher, dispenser straps are secure around launcher.

2. Electrical connection — Dispenser harness connected to helicopter receptacle. Jettison quick disconnect lanyard attached to harness and dispenser.

3. Grenades — Desired colors installed and safety pins removed.

4. Dispenser — Condition, ejector safety pins removed, and dispenser cocked.

4-11. BEFORE STARTING ENGINE CHECK.

NOTE

Check to be performed prior to starting engine. Chapter 8 preflight before starting engine check.

1. Pilot smoke grenade dispenser panel — Color indicating dials set to indicate color of grenades installed noted during exterior check.

2. Pilot PSI — Elevation/azimuth sightline position bars centered on reference ring, coarse scale azimuth pointer centered, ATTK/RDY/FIRE annunciators and ascent/descent pointers not displayed.

3. Gunner SHC ACQ/TRK/STOW switch — STOW.

4. Gunner TCP MODE SELECT switch — OFF, system status annunicator displays OFF.

5. Gunner TCP CAMERA switch — OFF.

6. Gunner TCP EXPOSURE switch — BRT.

7. Gunner TCP TSU RTCL switch — OFF

8. Gunner TCP MISSILE SELECT switch — 1.

9. Gunner AMMO RSV PERCENT dials — Set.

10. Pilot and gunner helmets — ON.

4-12. BEFORE TAKEOFF CHECK — ALL ARMAMENT — PREFLIGHT.

WARNING

The following checks shall not be performed with Tow Missiles installed.

NOTE

Check cannot be performed prior to engine start because hydraulic power is required for portions of the check.

a. HSS BUILT-IN-TEST CHECK.

1. Pilot and gunner HS arm assemblies — Attached to BIT Magnets.
2. Pilot MASTER ARM switch — STBY.
3. Pilot WPN CONT switch — GUNNER.
4. Pilot TURRET switch — BOTH.
5. Indicator light test — Press pilot and gunner ARMED/STBY, 7.62/7.62/40/40, and gunner PLT/GNR/INTFC/GO panels. All sections illuminate.
6. Gunner HSS BIT switch — BIT. Test passed if GO light illuminates, failed if PLT/GNR/INTFC lights illuminate. If failed, ensure HSS arm assemblies are properly attached to BIT magnets, check all cable connections, cycle MASTER ARM switch from STBY to OFF and back to STBY, and actuate BIT switch again..

b. HSS TO TURRET CHECK.

1. Pilot and gunner HS arm assemblies — Attach to helmet.
2. Pilot and gunner HS eyepieces — Extended over eye.
3. Gunner reticle — Adjust, focus, and test lights. HSS RETICLE OFF BRT control to be in full BRT. After adjust and focus, move HSS RETICLE TEST switch to TEST. If reticle goes out, one or more lights may have failed.
4. Gunner HS to turret check — TSU left hand grip ACTION switch depressed, gunner moves head, turret follows head movement, reticle flashes until gun line is coincident with HSS line. Release ACTION switch.

WARNING

In the following check, do not press the gunner cyclic TRIGGER TURRET FIRE switch.

5. Gunner emergency mode check — Gunner PLT OVRD switch in OVRD and cyclic TRIGGER ACTION switch depressed, repeat step 4 above, then PLT OVRD switch to OFF.
6. Pilot WPN CONT switch — PLT. Pilot reticle — Adjust, focus, and test lights. HS RTCL OFF BRT control to be in full BRT. After adjust and focus, move HS RTCL TEST switch to TEST. If reticle goes out, one or more lights may have failed.
7. Pilot HS to turret check — Cyclic TRIGGER ACTION switch depressed, pilot moves head, turret follows head movement. Pilot makes rapid rotational head movement, reticle flashes until gun line is coincident with HS line. Release TRIGGER ACTION switch.

c. *TOW BUILT-IN-TEST CHECK.*

1. Pilot WPN CONT switch — GUNNER.

2. Gunner TCP MODE SELECT switch — STBY TOW, system status annunciator OFF, after 10 seconds. TEST, before two minutes PWR ON, TSU/SCA/EPS/MCA fail indicators display black flags. Black flag indicates automatic BIT passed, white flag indicates failure.

3. Gunner TCP BIT switch — Hold, gunner TSU reticle ATTK/RDY/GUNS indicators, pilot PSI ATTK/RDY/FIRE annunciators, and ascend/descent pointers displayed. Release switch.

4. Gunner TCP and pilot MSP missile status indicators — Displays missile load configuration noted during exterior check.

5. BIT override check — TCP MODE SELECT switch OFF, then STBY TOW, when TCP annunciator displays TEST, move ACQ/TRK/STOW switch from STOW to TRK, annunciator displays PWR ON.

6. *TOW BIT (Performed above) Information.* Automatic or manual BIT may be performed before, during, or after operations.

   (a) TOW BIT Initiation.

   1. Gunner SHC ACQ/TRK/STOW switch — STOW.

   2. Automatic BIT — Gunner TCP MODE SELECT switch from OFF to TSU/GUN or STBY TOW.

   3. Manual BIT — When gunner TCP system status annunciator displays PWR ON, press and release TCP BIT switch.

   (b) TOW BIT Termination.

   1 Automatic or Manual Bit — Automatically completed within two minutes.

   2. Termination During BIT. Gunner SHC ACQ/TRK/STOW switch set to ACQ or TRK or TCP MODE SELECT switch set to MAN ARMED, AUTO ARMED, or OFF.

d. TSU FAST RATE TRACKING CHECK.

1. Gunner — Look into TSU eyepiece during check. Mode select switch STBY TOW.

2. LHG MAG switch — LO. Switch must be positively held in position before releasing. TSU eyepiece displays low magnification (two power) of target.

3. SHC track control stick — Move full left and down. TSU rapidly moves left and down. ACQ/TRK/STOW switch to TRK.

4. SHC track control stick — Release. TSU view not rotating. Pilot PSI azimuth sightline position bar and course scale azimuth pointer full left, elevation sightline position bar full down.

e. TSU SLOWRATE TRACKING CHECK.

1. Gunner — Look into TSU eyepiece during check. Mode select switch STBY TOW.

2. LHG MAG switch — HI. Switch must be positively held in position before releasing. TSU eyepiece displays high magnification (13 power) of target.

3. SHC track control stick — Move full right and up. TSU slowly moves right and up.

4. SHC track control stick — Release. TSU view not rotating. Pilot azimuth sightline position bar and course scale azimuth pointer full right, elevation sightline position bar full up.

f. TOW MOTION COMPENSATION CHECK.

1. Gunner — Look into TSU eyepiece during check.

2. LHG ACTION switch — Press.

3. SHC track control stick — Move left and down. Release when TSU starts moving, TSU continue to move.

4. LHG Action switch — Release. TSU stops.

g. TSU STOW POSITION AND RETICLE CHECK.

1. Gunner — Look into TSU eyepiece during check.

2. TCP RTCL switch — Rotate. Reticle light intensity varies.

3. SHC ACQ/TRK/STOW switch — STOW. TSU returns to stow position.

h. HSS TO TSU CHECK.

1. Pilot and gunner HS eyepieces — Extended over eye.
2. Gunner HS reticle — On a target.
3. SHC ACQ/TRK/STOW switch — ACQ.
4. SHC ACQ/TRK/STOW switch — Released. Returns TRK. Gunner HS eyepiece retracts.
5. TSU reticle — Displayed target.
6. Gunner HS eyepiece — Extended over eye.
7. Pilot HS reticle — On another target.
8. SHC PHS ACQ switch — Press.
9. SHC PHS ACQ switch — Released. Gunner HS eyepiece retracts.
10. TSU reticle — Displays pilot target.
11. ACQ/TRK/STOW — STOW.
12. LHG MAG switch — LO.
13. TCP — TSU/Guns.

i. Before Takeoff Check—All Armament.

1. Gunner PLT ORIDE switch—OFF.
2. PILOT MASTER ARM switch—STBY.
3. TCP—TSU/GUN.
4. TOW launchers—Missile arming lever down.
5. Wing ejector rack jettison safety pins—Removed.

4-13. INFLIGHT PROCEDURES — ALL ARMAMENT.

The following armament inflight procedure paragraphs are based on only one weapon installed, all armament circuit breakers in, and armament preflight interior check performed. Refer to figure 4-3 for firing modes when two or more weapons are installed.

4-14. TURRET OPERATION — INFLIGHT PROCEDURES.

a. Gunner Operation — Turret.

1. Pilot MASTER ARM switch — ARM.
2. Pilot WPN CONT switch — GUNNER.
3. Pilot TURRET switch — As desired.
4. Gunner PLT OVRD switch — OFF.
5. Gunner RANGE switch — As desired.
6. Gunner COMP switch — ON.
7. Gunner TURRET DEPR LIMIT switch - OFF.
8. Gunner TCP MODE SELECT switch - TSU/GUN.
9. Gunner LHG ACTION switch — Depressed
10. Gunner HS/TSU reticle — ON target.
11. Gunner LHG TRIGGER switch - Depressed. Machine gun — First detent 2000 rounds per minute, second detent 4000. Grenade launcher — First or second detent 400 grenades per minute.
12. Emergency procedures — Refer to Chapter 9 Section II.

b. Pilot Operation — Turret.

1. Pilot MASTER ARM switch — ARM.
2. Pilot WPN CONT switch — PLT when using helmet sight (HS), FIXED when using refle sight.
3. Pilot TURRET switch — As desired.
4. Gunner PLT OVRD switch — OFF.
5. Gunner RANGE switch — As desired.
6. Gunner COMP switch — ON.
7. Gunner TURRET DEPR LIMIT switch - OFF.

8. Pilot reflex sight — Set when using reflex sight.

9. Pilot cyclic TRIGGER ACTION switch — depressed when using HS.

10. Pilot HS/reflex sight reticle — On target.

11. Pilot cyclic TRIGGER TURRET FIRE switch — Depressed. Machine gun — First detent 2000 rounds per minute, second detent 4000. Grenade launcher — First or second detent 400 grenades per minute.

12. Emergency procedures — Refer to Chapter 9, Section III.

4-15. TOW Operation — Inflight Procedures.

1. Pilot MASTER ARM switch — ARM.

2. Pilot WPN CONT switch — GUNNER.

3. Gunner TCP MODE SELECT switch — ARMED MAN for manual missile selection, ARMED AUTO for automatic missile selection.

4. Gunner TSU LHG MAG switch — LO. Switch must be positively held in position before releasing.

5. Gunner TSU reticle — Focus.

6. Gunner TCP CAMERA/EXPOSURE switches — As required.

7. Gunner TCP MISSILE SELECT switch — Set to first loaded missile, pilot informed of missile selected, pilot MSP displays SEL for missile position indicator.

8. Gunner SHC ACQ/TRK/STOW switch — ACQ.

9. Gunner HS reticle — On target.

10. Gunner SHC ACQ/TRK/STOW switch — TRK.

11. Gunner TSU reticle — On target.

12. Gunner TSU LHG MAG switch — HI. Switch must be positively held in position before releasing.

13. Gunner SHC track control stick — Move as required to keep TSU crosshairs on target.

14. Gunner TSU LHG ACTION switch — Depressed. Gunner TSU reticle ATTK indicator comes on, pilot PSI ATTK annunciator appears. LHG action switch depressed provide motion compensation during tracking.

15. Helicopter position — Maneuvered to align pilot PSI sightline position bars within prelaunch constraint boundary and maintained a roll attitude of less than ± 5°. Gunner TSU reticle RDY indicator comes on, pilot PSI RDY annunciator appears.

16. Pilot PSI sightline position bars — Crosses PSI reference ring, pilot begins countdown for gunner. "Standby . . . . . ready."

NOTE

Gunner cannot fire if the helicopter is not within the prelaunch constraint boundary. Gunner can override the prelaunch constraint boundary limitation by pressing the CONST OVRD switch on the SHC. If this mode of operation is employed, degraded system performance can be expected.

NOTE

Smoke may emerge from launcher after TRIGGER is depressed and before missile exits launcher. The smoke is caused by the missile gyro and battery squibs firing and should not be regarded as a misfire. A misfire has occurred if missile fails to exit launcher within 1.5 seconds (pilot PSI RDY annunciator disappears).

17. Gunner TSU LHG TRIGGER switch — Depressed when helicopter is within range of target. Pilot PSI FIRE annunciator appear. After 1.5 seconds, pilot PSI ATTK and RDY annunciators disappear, gunner TSU reticle ATTK and RDY indicators go out.

WARNING

Do not turn helicopter to the side from which a missile is fire. The helicopter may strike the command wire.

18. Helicopter position — Maneuvered to keep pilot PSI sightline position bars within postlaunch constraint boundary until wire cut or missile impact.

CAUTION

Loss of missile guidance could result if a drastic maneuver (exceeding postlaunch constraint boundary) is made.

19. Gunner TSU reticle crosshairs — On target until wire cut or missile impact. Gunner SHC track control stick used to keep crosshairs on target.

20. Additional missile firing — The next missile is selected automatically if the gunner TCP MODE SELECT switch is on ARMED AUTO, manually selected if switch is on ARMED MAN by the MISSILE SELECT switch.

    a. Pilot MSP — Displays SEL for missile selected.

    b. Gunner TSU LHG MAG switch — LO. Switch must be positively held in position before releasing.

    c. Fire missile — Repeat paragraphs 4-15.9 through 4-15.19.

21. Emergency procedures — Refer to Chapter 9, Section II.

4-16. Rocket Operation — Inflight Procedures.

1. Pilot MASTER ARM switch — ARM.
2. Gunner PLT OVRD switch — OFF.
3. Pilot RKT PR SEL switch — As desired.
4. Pilot WG ST ARM switch — As required. ARMED indicator comes on.
5. Pilot reflex sight — Adjust and align w target.
6. Pilot cyclic WING ARM FIRE switch Depressed.

4-17. Wing Gun Pod Operation — Inflight Procedures.

1. Pilot MASTER ARM switch — ARM.
2. Gunner PLT OVRD switch — OFF.

WARNING

If rockets are being fired, the pilot cyclic WING ARM FIRE switch must be released prior to moving WG ST ARM switch from OUTBD to INBD. WING gun pod rounds may detonate inflight rockets in proximity of helicopter.

3. Pilot WG ST ARM switch — INB ARMED indicator comes on.
4. Pilot reflex sight — Adjust and align wi target.
5. Pilot cyclic WING ARM FIRE switch Depressed.

4-18. Smoke Grenade Dispenser Operation – Inflight Procedures.

1. Pilot MASTER ARM switch — STBY ARM.
2. Gunner PLT OVRD switch — OFF.
3. Pilot LH ARM and RH ARM switches As desired.
4. Pilot SMOKE REL switch — Depress

4-19. Wing Stores Jettison — Inflight Procedures. Refer to Chapter 9, Section I.

4-20. BEFORE LANDING CHECK — ALL ARMAMENT.

1. Gunner PLT OVRD switch — OFF.

2. Pilot MASTER ARM switch—STBY.
3. TCP—TSU/GUN.

4-21. BEFORE LEAVING HELICOPTER CHECK — ALL ARMAMENT.

1. TOW Missile engaging handle — Up.
2. Wing ejector rack jettison safety pins — Installed.

WARNING

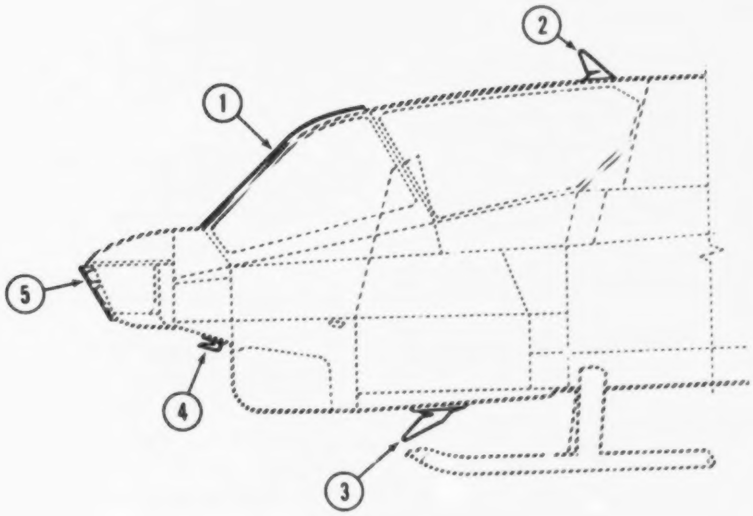
Ensure rocket igniter arms are in contact with firing disk. Igniter arms provide path to ground thereby preventing ignition caused by electromagnetic radiation.

3. Rocket igniter arms — In contact with rockets.

SECTION III. PASSIVE DEFENSE

4-22. WIRE STRIKE PROTECTION SYSTEM.

The wire strike protection system (figure 4-23) consists of three cutter assemblies, a windshield deflector and a nose deflector. An upper cutter assembly is mounted on top of the pilot station, forward of the ADF loop ante na. A chin cutter assembly is mounted under the nos just forward of the gunner station. A lower cutt assembly is mounted on the forward fuselage, under th ammunition compartment.



1. Windshield Deflectors
2. Upper Cutter Assembly
3. Lower Cutter Assembly
4. Chin Cutter Assembly
5. Nose Deflector

Figure 4-23. Wire Strike Protection System

CHAPTER 5

OPERATING LIMITS AND RESTRICTIONS

Section I. GENERAL

5-1. Purpose.

This chapter identifies or refers to all important operating limits and restrictions that shall be observed during ground and flight operations.

5-2. General.

The operating limitations set forth in this chapter are the direct results of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum utility from the helicopter. Limits concerning maneuvers, weight, and center of gravity limitations are also covered in this chapter.

5-2A. Exceeding Operational Limits.

a. Any time an operational limit is exceeded an appropriate entry shall be made on DA Form 2408-13. Entry shall state what limit or limits were exceeded, range, time above limits, and any additional data that would aid maintenance personnel in the maintenance action that may be required.

b. The instruments in the pilot's station are the primary reference for determining aircraft operating limits.

5-3. Minimum Crew Requirements.

a. The minmum crew requirement consists of a pilot whose station is in the aft cockpit.

b. Deleted.

Section II. SYSTEM LIMITS

5-4. Instrument Markings. (Figure 5-1)

a. Instrument Marking Color Codes. Operating limitations and ranges are illustrated by the colored markings which appear on the dial faces of engine, flight and utility system instruments. RED markings on the dial faces of these instruments indicate the limit above or below which continued operation is likely to cause damage or shorten life. The GREEN markings on instruments indicate the safe or normal range of operation. The YELLOW markings on instruments indicate the range when special attention should be given to the operation covered by the instrument. Operation is permissible in the yellow range, provided no other operating limit is exceeded. White strips dividing red markings on dial faces provide high and/or low limitation visibility when operating in the night vision environment.

b. Instrument Glass Alignment Marks: Limitation markings consist of strips of semi-transparent color tape which adhere to the glass outside of an indicator dial. Each tape strip aligns to increment marks on the dial face so correct operating limits are portrayed. The pilot should occasionally verify alignment of the glass to the dial face. For this purpose, all engine instruments have short, vertical white alignment marks extending from the bottom part of the dial glass onto the fixed base of the indicator. These slippage marks appear as a single vertical line when limitation markings on the glass properly align with reading increments on the dial face. However, the slippage marks appear as separate radial lines when a dial glass has rotated.

5-5. Rotor Limitations.

a. Normal Operating Range. Refer to figure 5-1.

b. Wind Limitations. Helicopter can be started in a maximum wind velocity of 30 knots or a maximum gust spread of 15 knots. Gust spreads are not normally reported. To obtain spread, compare minimum and maximum wind velocity.

5-6. Deleted.

Section III. POWER LIMITS

5-7. Engine Limitations. (Figure 5-1)

a. Engine overspeed; an engine overspeed exists under the following conditions.

(1) When N1 speed exceeds 106 percent.

(2) When N2 exceeds 6900 rpm.

(3) When N2 is between 6700 and 6900 rpm for more than ten seconds with TGT above 750°C.

NOTE

> The red line at 6600 rpm on the engine tachometer (figure 5-1) represents the power-on rotor speed limit. Even though an engine write-up is not required unless the rpm limits of paragraph 5-7a(2) and (3) are exceeded, willful operation shall not be conducted with engine rpm above the red line limit of 6600 rpm.

b. Maximum oil consumption is 0.3 gallon (2.4 pin per hour.

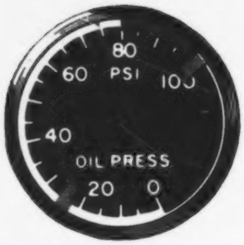
c. Maximum starter energize time is 35 seconds w a one minute cooling time between start attempts, w three attempts in any one hour.

d. Maximum TGT for environmental control u operation is 820°C.

e. 6000 to 6400 rpm N2 transient.

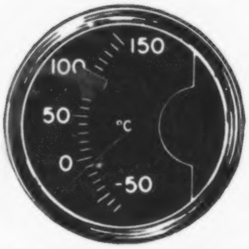
5-8. Deleted.

5-9. Deleted.


80
60
PSI
100
40
OIL PRESS
20
0

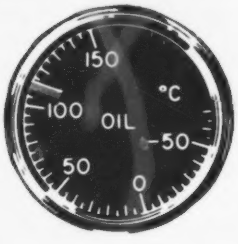
ENGINE OIL PRESSURE

🟥 25 PSI Minimum
🟩 80 to 100 PSI Continuous Operation
🟥 100 PSI Maximum


150
100
50
°C
0
-50

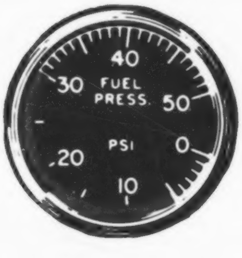
ENGINE OIL TEMPERATURE

🟥 93 C Maximum below 30° C FAT
100°C maximum at or above 30°FAT
(Write-up is required any time 93°C
is exceeded)


150
°C
100
OIL
-50
50
0

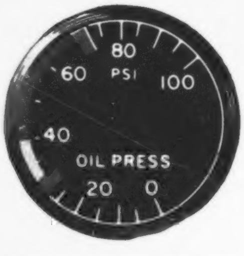
TRANSMISSION OIL TEMPERATURE

🟥 110°C Maximum


40
30
FUEL PRESS.
50
PSI
0
20
10

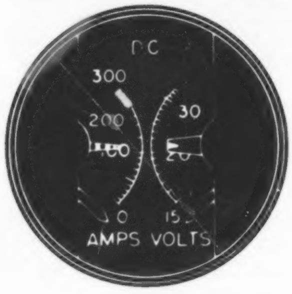
FUEL PRESSURES

🟩 5 to 30 PSI Continuous Operation


80
60
PSI
100
40
OIL PRESS
20
0

TRANSMISSION OIL PRESSURE

🟥 30 PSI Minimum
🟨 30 to 40 PSI only below 6000 RPM (N2)
🟩 40 to 70 PSI Continuous Operation
🟥 70 PSI Maximum

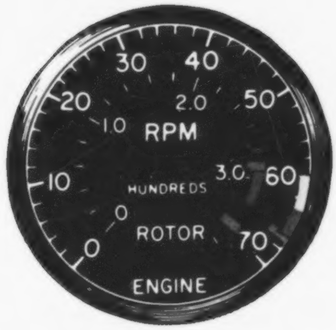

DC
300
200
100
30
20
0
15
AMPS
VOLTS

VOLT — AMP METER

🟨 200 to 300 AMPS
AVOID CONTINUOUS OPERATION
ABOVE 200 AMPS

Figure 5-1. Instrument markings (Sheet 1 of 2)

▨
▨
☐

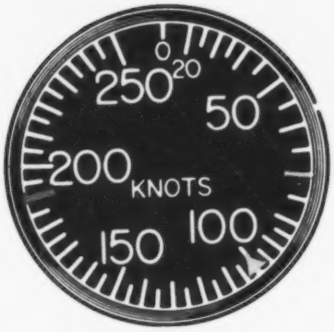

30
40
20
2.0
50
1.0
RPM
10
HUNDREDS
3.0
60
0
0
ROTOR
70
ENGINE

ROTOR TACHOMETER

▨ 294 RPM Minimum
▨ 294 to 324 RPM Continuous Operation
▨ 339 RPM Maximum

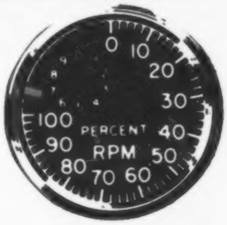
ENGINE TACHOMETER

☐ 6000 to 6400 RPM Transient
▨ 6400 to 6600 RPM Continuous Operation
▨ 6600 RPM Maximum


0
20
250
50
200
KNOTS
150
100

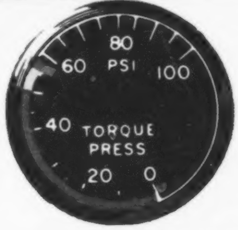
AIRSPEED

☐ 70 KIAS Not applicable
100 KIAS Maximum above 50 PSI Torque
▨ 190 KIAS Maximum Clean Configuration


0
10
20
30
100
PERCENT
40
90
RPM
50
80
70
60

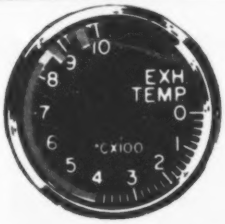
GAS PRODUCER TACHOMETER

▨ 106.0 Percent Maximum


80
60
PSI
100
40
TORQUE
PRESS
20
0

TORQUE PRESSURE

▨ 0 to 50 PSI Continuous Operation
☐ 50 to 56 PSI 30 Minute Limit
▨ 56 PSI Maximum


10
9
8
EXH
TEMP
7
0
6
°CX100
1
5
4
3
2

TURBINE GAS TEMP

▨ 400°C to 820°C Continuous Operation (normal power)
☐ 820°C to 880°C 30 Minute Limit (military power)
▨ 880°C through 950°C Transient for Starting and Acceleration (5 seconds)
▨ 950°C Maximum for Starting

Figure 5-1. Instrument markings (Sheet 2 of 2)

Section IV. LOADING LIMITS

5-10. Center of Gravity Limitations.

Center of gravity limits for the aircraft to which this manual applies and instructions for computation of the center of gravity are contained in Chapter 6.

NOTE

The lateral cg limits are 2.0 inches (2 inches to the right and left of centerline of helicopter). These limits cannot be exceeded due to normal weapon firing sequence and stores jettison procedure.

5-10A. Turbulence Restrictions.

Intentional flight into severe or extreme turbulence is prohibited.

5-11. Weight Limitations.

a. The maximum gross weight for this helicopter is 10,000 pounds.

b. Aircraft with single hydraulic system capability (collective authority check results) of less than 48 PSI torque but more than 40 PSI torque may be operated with restrictions. The aircraft configuration and gross weight shall be limited such that, in the event of a hydraulic system failure, a gross weight is achievable (jettisoning wing stores as appropriate) which does not exceed that corresponding to a 5 feet IGE hover capability at the recorded torque value.

5-12. Deleted.

Section V. AIRSPEED LIMITATIONS

5-13. Airspeed Limitations.

a. Refer to Figure 5-3 for forward airspeed limits.

b. Sideward flight limit is 35 KIAS.

c. Rearward flight limit is 30 KIAS.

d. Airspeed limit for indicated torque greater than 50 psi is 100 KIAS. Airspeed limit for indicated torque greater than 35 psi is 150 KIAS.

e. Maximum airspeed for TOW missile firing is 150 knots.

f. Steady state autorotation limit is 120 KIAS.

g. Maximum steady-state airspeed with SCAS OFF is 100 knots. With SCAS inoperative and at airspeed in excess of 100 KIAS, uncommanded roll, pitch, and yaw oscillations will occur. The magnitude of the oscillation will increase as airspeed increases. Due to the nature of the oscillation, there is a tendency to introduce pilot induced oscillations which further aggravate the condition. Additionally, high power settings should be avoided when operating at airspeeds between 60 and 100 KIAS with inoperative roll and yaw SCAS channel because of instability.

h. Deleted.

Figure 5-1A. Deleted.

5-14. Deleted.

5-15. Canopy Door Limitations.

The canopy door shall not be opened in flight except as outlined in emergency procedures, Chapter 9.

Section VI. MANEUVERING LIMITS

5-16. Prohibited Maneuvers.

a. Abrupt inputs of flight controls cause excessive main rotor flapping, which may result in mast bumping and must be avoided.

b. No aerobatic maneuvers permitted.

c. Intentional flight below +0.5 "G's" is prohibited. Refer to "Low G Maneuvers", Chapter 8, paragraph 8-70.

d. Practice autorotations and/or rapid throttle setting reduction at airspeeds greater than 150 KIAS are prohibited when indicated engine torque pressure is greater than 35 psi.

e. The speed for any and all maneuvers shall not exceed the airspeeds as stated on the Airspeed Operating Limit Chart, Figure 5-3.

5-16A. Deleted.

All data on pages 5-6A and 5-6B, including Figure 5-2 is deleted.

AIRSPEED OPERATING LIMITS

324 ROTOR/6600 ENGINE RPM

AIRSPEED
OPERATING
LIMITS
AH-1S
T53-L-703

EXAMPLE

WANTED

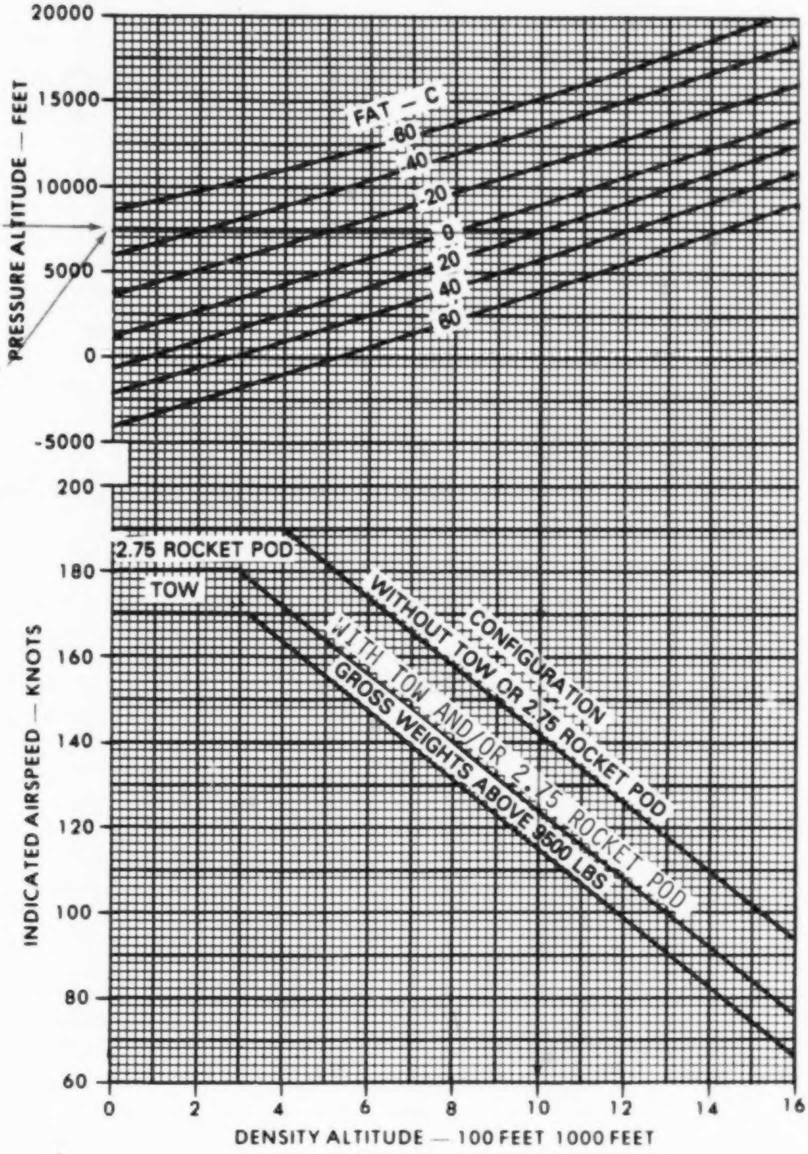
INDICATED AIRSPEED
AND DENSITY ALTITUDE

KNOWN

TOW CONFIGURATION
PRESSURE ALTITUDE = 7500 FEET
FAT = +20°C

METHOD

ENTER PRESSURE ALTITUDE HERE →
MOVE RIGHT TO FAT
MOVE DOWN TO CONFIGURATION
MOVE LEFT, READ INDICATED
AIRSPEED = 124 KNOTS
REENTER PRESSURE ALTITUDE HERE →
MOVE RIGHT TO FAT
MOVE DOWN, READ DENSITY
ALTITUDE = 10000 FEET



DATA BASIS: DERIVED FROM BELL HELICOPTER TEXTRON FLIGHT TEST

Figure 5-3. Airspeed operating limits chart

Section VII. ENVIRONMENTAL RESTRICTIONS

5-17. Environmental Restrictions.

a. This helicopter is not qualified for flight under instrument meteorological conditions.

b. Environmental restrictions; refer to S tions III and V of Chapter 8.

Section VIII. HEIGHT VELOCITY

5-18. Deleted.

All data on page 5-9/5-10, including Figure 5-4 is deleted.

MINIMUM HEIGHT FOR SAFE LANDING AFTER ENGINE FAILURE
324 ROTOR RPM

MINIMUM HEIGHT
AH-1S
T53-L-703

EXAMPLE A

WANTED

CALIBRATED AIRSPEED
INDICATED AIRSPEED

KNOWN

DENSITY ALTITUDE = SEA LEVEL
SKID HEIGHT ABOVE GROUND = 410 FEET

METHOD

ENTER SKID HEIGHT HERE
MOVE RIGHT TO DENSITY ALTITUDE
MOVE DOWN, READ CALIBRATED
AIRSPEED = 42 KNOTS
CONTINUE DOWN, READ INDICATED
AIRSPEED = 40 KNOTS

EXAMPLE B

WANTED

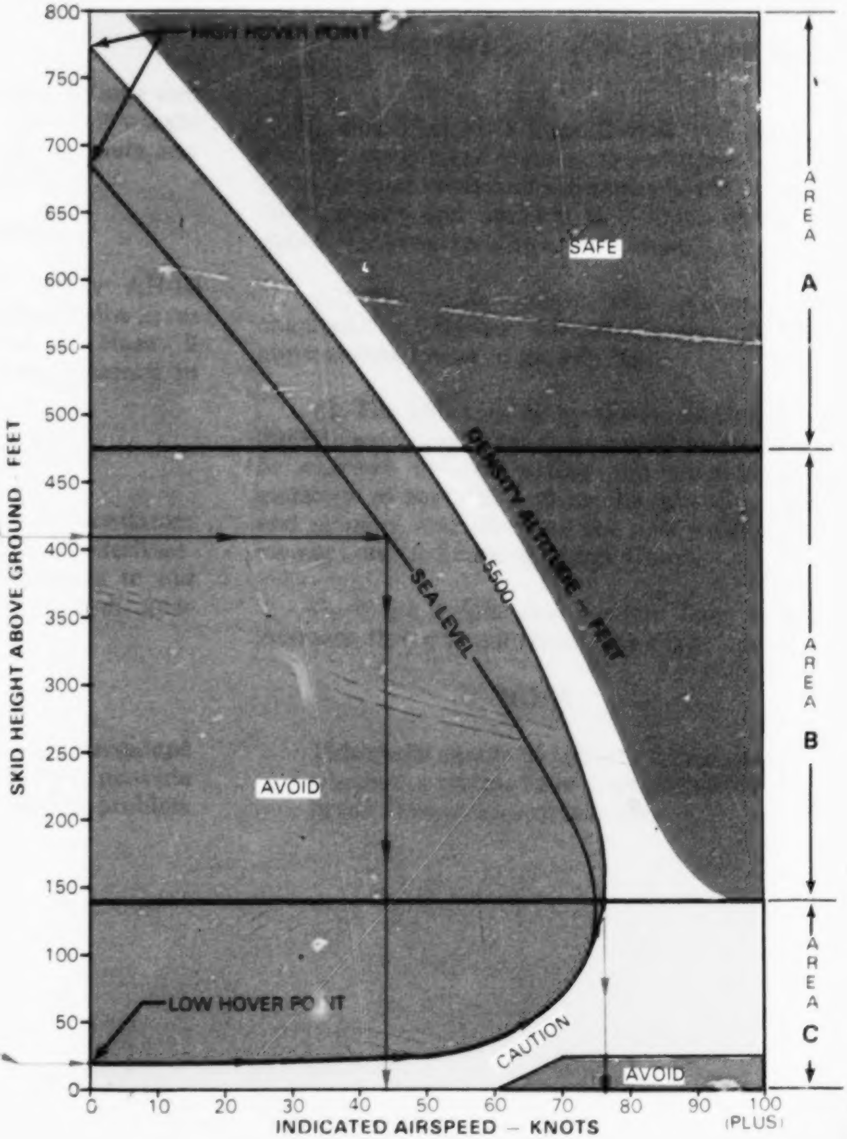
MINIMUM INDICATED AIRSPEED
FOR CLIMBOUT TO AVOID
HEIGHT VELOCITY RESTRICTIONS

KNOWN

DENSITY ALTITUDE = 5500 FEET
LOW HOVER POINT = 20 FEET
SKID HEIGHT ABOVE GROUND

METHOD

ENTER DENSITY ALTITUDE HERE
(AT LOW HOVER POINT)
MOVE RIGHT ALONG THE
DENSITY ALTITUDE LINE
TO THE FASTEST AIRSPEED
MOVE DOWN, READ INDICATED
AIRSPEED 73 KNOTS



DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 69-13, FEBRUARY 1971

209900-485D

Figure 5-4 Minimum height for safe landing after engine failure chart

CHAPTER 6

WEIGHT/BALANCE AND LOADING

Section 1. GENERAL

6-1. General.

Chapter 6 contains sufficient instructions and data so that an aviator knowing the basic weight and moment of the helicopter can compute any combination of weight and balance.

6-2. Classification of Helicopter.

For the purpose of clarity, Army AH-1S helicopters are in class 2. Additional directives governing weight and balance of class 2 helicopter forms and records, are contained in AR 95-16 and TM 55-1500-342-23.

6-3. Helicopter Station Diagram.

Figure 6-1 shows the helicopter reference datum lines, fuselage stations, buttlines, and waterlines. The primary purpose of the figure is to aid personnel in the computation of helicopter weight/balance and loading.

6-4. Loading Charts.

a. *Information.* The loading data contained in this chapter are intended to provide information necessary to work a loading problem for the helicopters to which this manual is applicable.

b. *Use.* From the figures contained in this chapter, weight and moment are obtained for all variable load items and are added to the current basic weight and moment (DD Form 365C) to obtain the gross weight and moment.

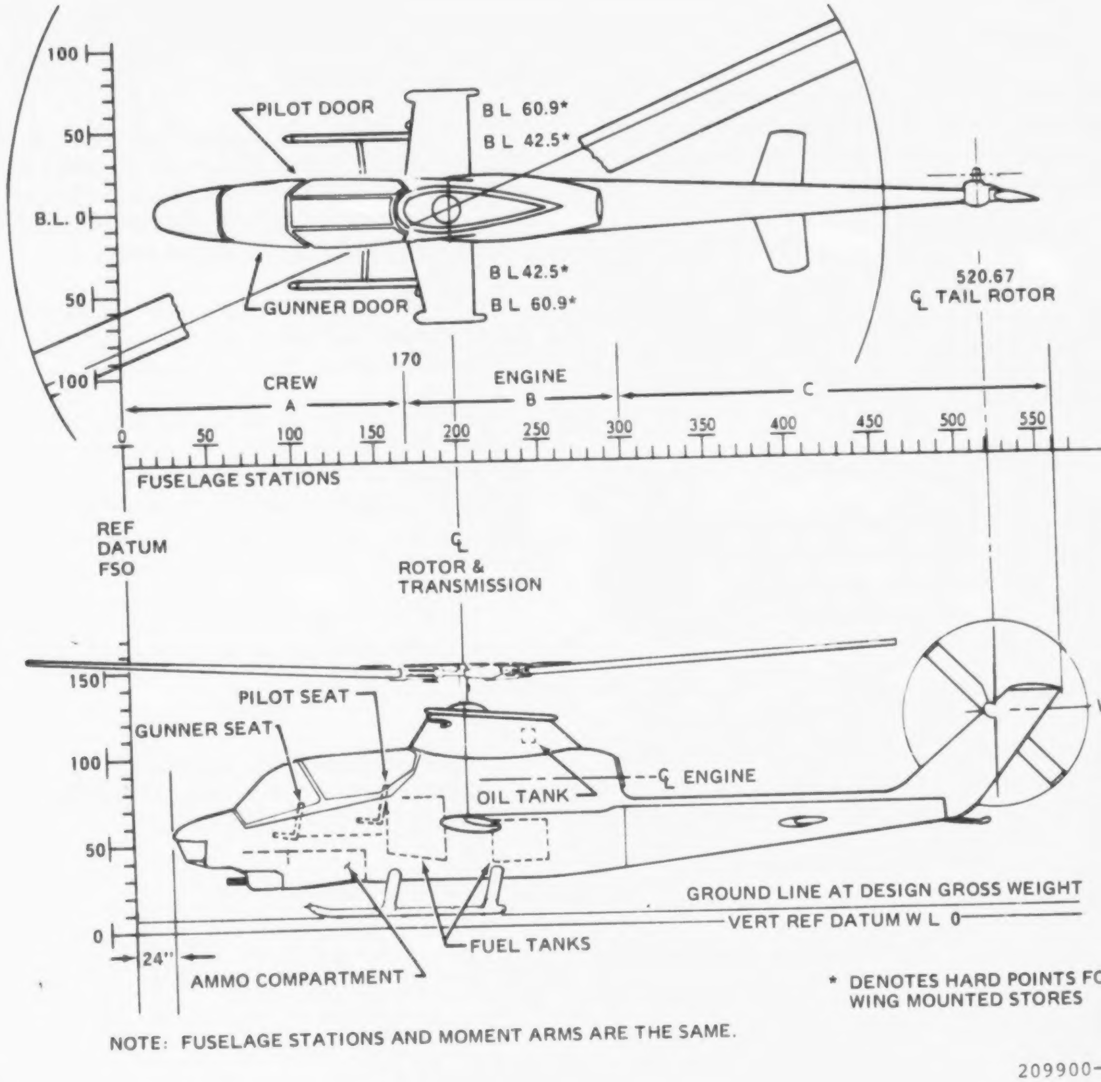
(1) The gross weight and moment are checked on figure 6-8 to determine the approximate center of gravity (cg).

(2) The effect on cg by the expenditures in flight of such items as fuel, ammunition, etc., may be checked by subtracting the weights and moments of such items from the takeoff weight and moment and checking the new weight and moment on the Loading Limits Chart.

(3) If the weight and moment lines do not intersect, the cg is not within the flight limits.

NOTE

This check should be made to determine whether or not the cg will remain within limits during the entire flight.


100
50
B.L. 0
50
100
PILOT DOOR
B L 60.9*
B L 42.5*
B L 42.5*
B L 60.9*
GUNNER DOOR
520.67
℄ TAIL ROTOR
170
CREW
A
ENGINE
B
C
0
50
100
150
200
250
300
350
400
450
500
550
FUSELAGE STATIONS
REF
DATUM
FSO
℄
ROTOR &
TRANSMISSION
150
100
50
0
PILOT SEAT
GUNNER SEAT
℄ ENGINE
OIL TANK
GROUND LINE AT DESIGN GROSS WEIGHT
VERT REF DATUM W L 0
24"
FUEL TANKS
AMMO COMPARTMENT
* DENOTES HARD POINTS FO
WING MOUNTED STORES
209900-

NOTE: FUSELAGE STATIONS AND MOMENT ARMS ARE THE SAME.

Figure 6-1. Helicopter station diagram

All data on page 6-3, including figure 6-1 (Sheet 2 of 2) deleted.

Section II. WEIGHT AND BALANCE

6-5. Weight and Balance Records.

Weight and Balance forms are maintained in the helicopter historical file. Refer to Section II of TM 55-1500-342-23 for information on DD Forms 365-1, -3, and -4.

Section III. PERSONNEL

6-6. Personnel Moments.

Refer to figure 6-2 to compute pilot and gunner moments.

Section IV. MISSION EQUIPMENT

6-7. Weight and Balance Loading Data.

Refer to figures 6-3 through 6-6 for the quantity, weight, and moment of each armament item up to maximum load.

Section V. CARGO LOADING

Not Applicable

Section VI. FUEL/OIL

6-8. Fuel Data.

Refer to figure 6-7 for fuel quantity, weight, and moment.

6-9. Oil Data.

For weight and balance purposes, oil is conside
part of aircraft basic weight.

Section VII. ALLOWABLE LOADING

6-10. Allowable Loading.

Refer to figure 6-8 for allowable loading limits.

EXAMPLE

WANTED

PERSONNEL MOMENT

KNOWN

PERSONNEL WEIGHT = 180 POUNDS

SEAT POSITION IS GUNNER (FRONT) SEAT

METHOD

MOVE RIGHT FROM 180 POUNDS TO GUNNER POSITION LINE PROJECT DOWN TO READ MOMENT 100 OF 150 IN-LBS

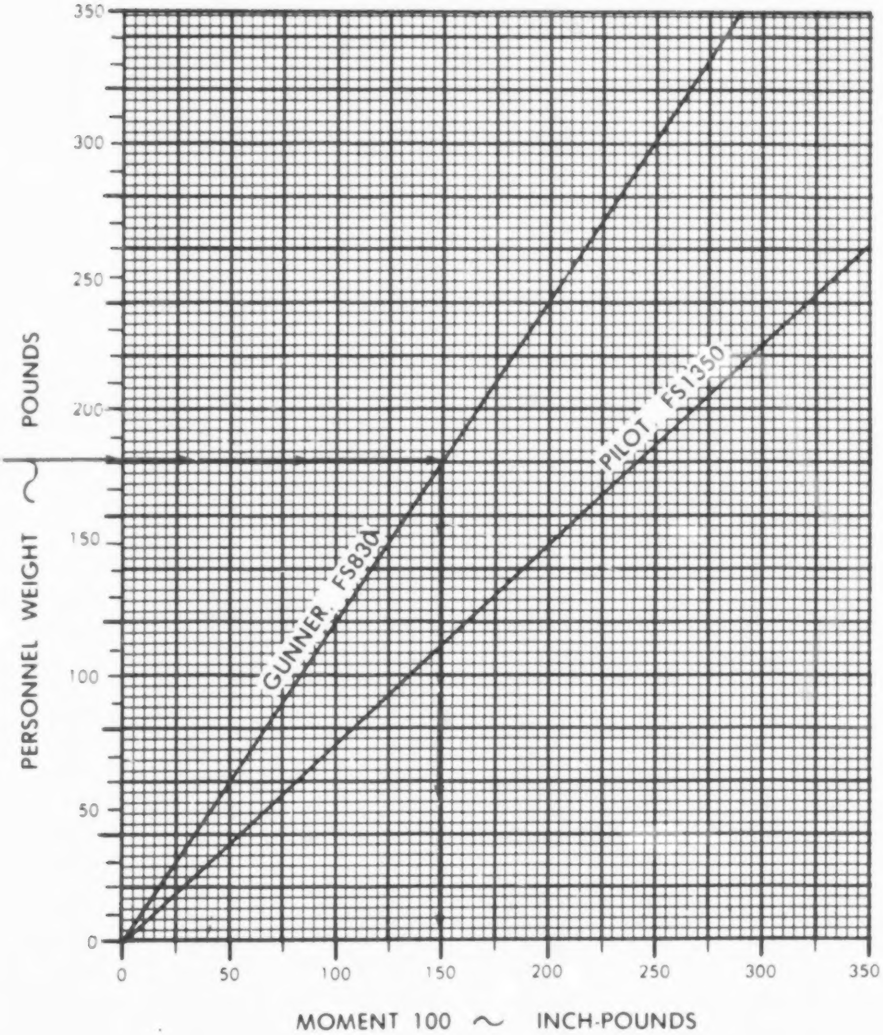


Figure 6-2. Personnel Moment Chart

M151 WARHEAD/M423 FUSE
(10 POUND WARHEAD WITH POINT DETONATING FUSE)

M159C POD*			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	152	302	311
1	173	343	353
2	193	383	394
3	214	423	435
4	234	463	477
5	255	503	518
6	275	543	559
7	296	583	601
8	316	623	642
9	337	663	683
10	357	703	725
11	378	744	766
12	398	784	807
13	419	824	850
14	439	864	890
15	460	904	933
16	480	944	973
17	501	984	1016
18	521	1024	1057
19	542	1064	1099
*S/N 004041 & SUB	M200A1 POD		
0	139	277	285
1	160	318	326
2	180	358	368
3	201	398	409
4	221	438	450
5	242	478	492
6	262	518	533
7	283	558	574
8	303	598	616
9	324	638	657
10	344	678	698
11	365	719	740
12	385	759	781
13	406	799	823
14	426	839	864
15	447	879	906
16	467	919	947
17	488	959	990
18	508	999	1030
19	529	1039	1073

ROCKETS @ 20.5 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 1 of 23)

M151 WARHEAD/M429 FUSE
(10 POUND WARHEAD WITH PROXIMITY FUSE)

M159C POD*			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	152	302	311
1	173	343	353
2	194	384	395
3	214	424	437
4	235	465	478
5	256	505	520
6	277	546	562
7	298	587	604
8	318	627	646
9	339	667	688
10	360	708	730
11	381	749	771
12	402	790	813
13	422	830	856
14	443	871	898
15	464	912	941
16	485	952	984
17	506	993	1026
18	526	1033	1109
19	547	1074	1151
*S/N 004041 & SUB	M200A1 POD		
0	139	277	285
1	160	318	327
2	181	359	369
3	201	399	411
4	222	440	452
5	243	480	494
6	264	521	536
7	285	562	578
8	305	602	620
9	326	642	662
10	347	683	704
11	368	724	745
12	389	765	787
13	409	805	829
14	430	846	872
15	451	887	915
16	472	927	957
17	493	968	1000
18	513	1008	1040
19	534	1049	1083

ROCKETS @ 20.8 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 2 of 23)

XM229 WARHEAD/M423 FUSE
(17 POUND WARHEAD WITH POINT DETONATING FUSE)

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
M159C POD*			
0	152	302	311
1	180	355	366
2	208	408	420
3	236	461	475
4	264	514	529
5	292	567	584
6	319	620	638
7	347	672	693
8	375	725	747
9	403	778	802
10	431	831	856
11	459	884	911
12	487	937	965
13	515	989	
14	543	1042	
15	571	1095	
16	598	1148	
17	626	1201	
18	654	1254	
19	682	1306	
M200A1 POD			
0	139	277	285
1	167	330	340
2	195	383	394
3	223	436	449
4	251	489	503
5	279	542	558
6	306	595	612
7	334	647	667
8	362	700	721
9	390	753	776
10	418	806	830
11	446	859	885
12	474	912	939
13	502	964	
14	530	1017	
15	558	1070	
16	585	1123	
17	613	1176	
18	641	1229	
19	669	1281	

ROCKETS @ 27.9 LBS. EACH

*S/N 004041 & SUB

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 3 of 23)

XM229 WARHEAD M429 FUSE
(17 POUND WARHEAD WITH PROXIMITY FUSE)

M159C POD*			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	152	302	311
1	180	356	366
2	208	409	421
3	237	462	476
4	265	516	531
5	293	569	586
6	321	622	641
7	349	676	696
8	378	729	751
9	406	782	806
10	434	835	861
11	462	889	916
12	490	942	971
13	519	995	
14	547	1049	
15	575	1102	
16	603	1155	
17	631	1209	
18	660	1262	
19	688	1315	
M200A1 POD			
0	139	277	285
1	167	331	340
2	195	384	395
3	224	437	450
4	252	491	505
5	280	544	560
6	308	597	615
7	336	651	670
8	365	704	725
9	393	757	780
10	421	801	835
11	449	864	890
12	477	917	945
13	506	970	
14	534	1024	
15	562	1077	
16	590	1130	
17	618	1184	
18	647	1237	
19	675	1290	

ROCKETS @ 28.2 LBS. EACH

*S/N 004041 & SUB

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 4 of 23)

WDU-4A/A (FLECHETTE) WARHEAD
(9.3 POUND WARHEAD WITH DECELERATION ACTUATED FUSE)

M159C POD*			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	152	302	311
1	172	342	352
2	192	381	393
3	213	421	433
4	233	460	474
5	253	500	515
6	273	539	555
7	293	578	596
8	314	618	636
9	334	657	677
10	354	697	718
11	374	736	758
12	394	776	799
13	415	815	842
14	435	855	883
15	455	894	923
16	475	933	963
17	495	973	1004
18	516	1012	1046
19	536	1052	1087
*S/N 004041 & SUB	M200A1 POD		
0	139	277	285
1	159	317	326
2	179	356	366
3	200	395	407
4	220	435	448
5	240	475	488
6	260	515	529
7	280	554	570
8	301	593	610
9	321	633	651
10	341	673	692
11	361	713	732
12	381	752	773
13	402	792	815
14	422	831	856
15	442	871	896
16	462	910	937
17	482	950	977
18	503	990	1020
19	523	1029	1061

ROCKETS @ 20.2 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 5 of 23)

M151 WARHEAD/M423 FUSE
(10 POUND WARHEAD WITH POINT DETONATING FUSE)

M157A POD			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Momemt/100	Outboard Moment/100
0	57	113	116
1	78	152	157
2	98	191	197
3	119	230	237
4	139	269	278
5	160	308	318
6	180	347	358
7	201	386	398
M157B POD			
0	67	134	138
1	88	174	179
2	108	214	221
3	129	254	262
4	149	294	303
5	170	334	345
6	190	374	386
7	211	414	427

ROCKETS @ 20.5 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 6 of 23)

M151 WARHEAD/M423 FUSE
(10 POUND WARHEAD WITH POINT DETONATING FUSE)

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Momemt/100	Outboard Moment/100
M158 POD			
0	42	83	85
1	62	122	126
2	83	162	167
3	103	202	208
4	124	241	249
5	144	281	290
6	165	320	330
7	185	360	371
M158A-1 POD			
0	48	95	98
1	69	136	140
2	89	176	181
3	110	216	223
4	130	256	264
5	151	296	305
6	171	336	347
7	192	376	388

ROCKETS @ 20.5 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 7 of 23)

M151 WARHEAD/M423 FUSE
(10 POUND WARHEAD WITH POINT DETONATING FUSE)

M159B POD			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	118	234	241
1	139	273	281
2	159	312	321
3	180	351	362
4	200	390	402
5	221	429	442
6	241	468	483
7	262	507	523
8	282	546	563
9	303	585	603
10	323	624	644
11	344	663	684
12	364	702	724
13	385	741	781
14	405	780	821
15	426	819	864
16	446	858	904
17	467	897	947
18	487	936	988
19	508	975	1030
M159C * POD			
0	130	259	267
1	151	299	309
2	171	340	350
3	192	380	391
4	212	420	433
5	233	460	474
6	253	500	515
7	274	540	556
8	294	580	598
9	315	620	639
10	335	660	680
11	356	700	722
12	376	741	763
13	397	781	805
14	417	821	846
15	438	861	888
16	458	901	929
17	479	941	971
18	499	981	1012
19	520	1021	1055

*PRIOR TO S/N 004040　　ROCKETS @ 20.5 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 8 of 23)

M151 WARHEAD/M429 FUSE
(10 POUND WARHEAD WITH PROXIMITY FUSE)

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
M157A POD			
0	57	113	116
1	78	152	157
2	99	192	198
3	119	231	239
4	140	271	280
5	161	311	320
6	182	350	361
7	203	390	402
M157B POD			
0	67	134	138
1	88	174	180
2	109	215	222
3	129	255	263
4	150	296	305
5	171	337	347
6	192	377	389
7	213	418	431

ROCKETS @20.8 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 9 of 23)

M151 WARHEAD/M429 FUSE
(10 POUND WARHEAD WITH PROXIMITY FUSE)

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
M158 POD			
0	42	83	85
1	62	123	127
2	83	163	168
3	104	203	209
4	125	243	251
5	146	283	292
6	166	323	333
7	187	363	375
M158A-1 POD			
0	48	95	98
1	69	136	140
2	90	177	182
3	110	217	224
4	131	258	266
5	152	298	308
6	173	339	350
7	194	380	292

ROCKETS @ 20.8 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 10 of 23)

M151 WARHEAD/M429 FUSE
(10 POUND WARHEAD WITH PROXIMITY FUSE)

M159B POD			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	118	234	241
1	139	273	282
2	160	313	322
3	180	352	363
4	201	392	404
5	222	431	445
6	243	471	486
7	264	510	526
8	284	550	567
9	305	589	608
10	326	629	649
11	347	668	689
12	368	708	730
13	388	748	787
14	409	787	829
15	430	827	872
16	451	866	915
17	472	906	957
18	492	945	998
19	513	985	1040
*PRIOR TO S/N 004040	M159C* POD		
0	130	259	267
1	151	300	309
2	172	341	351
3	192	381	393
4	213	422	435
5	234	462	476
6	255	503	518
7	276	544	560
8	296	584	602
9	317	625	644
10	338	665	686
11	359	706	727
12	380	747	769
13	400	787	811
14	421	828	854
15	442	868	896
16	463	909	939
17	484	950	982
18	504	990	1022
19	525	1031	1065

ROCKETS @ 20.8 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 11 of 23)

XM229 WARHEAD/M423 FUSE
(17 POUND WARHEAD WITH POINT DETONATING FUSE)

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
M157B POD			
0	67	134	138
1	95	187	192
2	123	239	247
3	151	292	301
4	179	345	356
5	207	398	411
6	234	451	465
7	262	504	520
*PRIOR TO S/N 004040	M159C * POD		
0	130	259	267
1	158	312	322
2	186	365	376
3	214	418	431
4	242	471	485
5	270	524	540
6	297	576	594
7	325	629	649
8	353	682	703
9	381	735	757
10	409	788	812
11	437	841	866
12	465	893	921
13	493	945	976
14	521	999	1031

ROCKETS @ 27.9 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 12 of 23)

XM229 WARHEAD/M429 FUSE
(17 POUND WARHEAD WITH PROXIMITY FUSE)

M157B POD

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	67	134	138
1	95	187	193
2	123	240	248
3	152	294	303
4	180	347	358
5	208	400	413
6	236	453	468
7	264	507	523

*PRIOR TO S/N 004040

M159C* POD

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	Inboard Moment/100	Outboard Moment/100
0	130	259	267
1	158	313	322
2	186	366	377
3	215	419	432
4	243	473	487
5	271	526	542
6	299	579	597
7	327	632	652
8	356	686	707
9	384	739	762
10	412	792	817
11	440	846	872
12	468	899	927
13	497	952	
14	525	1006	

ROCKETS @ 28.2 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 13 of 23)

XM229 WARHEAD/M423 FUSE
(17 POUND WARHEAD WITH POINT DETONATING FUSE)

M158 POD			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	42	83	85
1	70	135	139
2	97	187	193
3	125	239	247
4	153	291	301
5	181	343	354
6	209	395	408
7	237	447	462
M158A-1 POD			
0	48	95	98
1	76	148	153
2	104	201	208
3	132	254	262
4	160	307	317
5	188	360	371
6	215	413	426
7	243	465	480

ROCKETS @ 27.9 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 14 of 23)

XM229 WARHEAD/M429 FUSE
(17 POUND WARHEAD WITH PROXIMITY FUSE)

M158 POD			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	42	83	85
1	70	135	140
2	98	188	194
3	126	241	248
4	154	293	303
5	183	346	357
6	211	398	429
7	239	451	465
M158A-1 POD			
0	48	95	98
1	76	149	153
2	104	202	209
3	133	255	264
4	161	309	319
5	189	362	374
6	217	415	479
7	245	469	484

ROCKETS @ 28.2 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 15 of 23)

WDU-4A/A (FLECHETTE) WARHEAD
(9.3 POUND WARHEAD WITH DECELERATION ACTUATED FUSE)

M157A POD			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	57	113	116
1	77	151	156
2	97	190	196
3	118	228	235
4	138	266	275
5	158	305	315
6	178	343	354
7	198	382	394
M157B POD			
0	67	134	138
1	87	173	179
2	107	213	219
3	128	252	260
4	148	291	301
5	168	331	341
6	188	370	382
7	208	410	423

ROCKETS @ 20.2 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 16 of 23)

WDU-4A/A (FLECHETTE) WARHEAD
(9.3 POUND WARHEAD WITH DECELERATION ACTUATE FUSE)

M158 POD

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	42	83	85
1	62	122	126
2	82	161	166
3	102	200	206
4	122	238	246
5	143	277	286
6	163	316	326
7	183	355	366

M158A-1 POD

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	Inboard Moment/100	Outboard Moment/100
0	48	95	98
1	68	135	139
2	88	174	180
3	109	214	220
4	129	253	261
5	149	293	302
6	169	332	343
7	189	371	383

ROCKETS @ 20.2 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 17 of 23)

WDU-4A/A (FLECHETTE WARHEAD
(9.3 POUND WARHEAD WITH DECELERATION ACTUATED FUSE

M159B POD			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	118	234	241
1	138	272	281
2	158	311	320
3	179	349	360
4	199	387	399
5	219	426	439
6	239	464	479
7	259	502	518
8	280	541	558
9	300	579	597
10	320	618	637
11	340	656	676
12	360	694	716
13	381	733	
14	401	771	
15	421	809	
16	441	848	
17	461	886	
18	482	925	
19	502	963	
*PRIOR TO S/N 004040		M159C* POD	
0	130	259	267
1	150	299	308
2	170	338	349
3	191	378	389
4	211	417	430
5	231	457	470
6	251	496	511
7	271	535	552
8	292	575	592
9	312	614	633
10	332	654	674
11	352	693	714
12	372	733	755
13	393	772	
14	413	811	
15	433	851	
16	453	890	
17	473	930	
18	494	969	
19	514	1009	

ROCKETS @20.2 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 18 of 23)

M151 WARHEAD/M423 FUSE
(10 POUND WARHEAD WITH POINT DETONATING FUSE)

M260 LAUNCHER

Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	35	70	72
1	56	111	114
2	76	151	156
3	97	192	198
4	117	233	240
5	138	274	282
6	158	314	324
7	179	355	366
M261 LAUNCHER			
0	80	159	164
1	101	200	206
2	121	240	248
3	142	281	290
4	162	322	332
5	183	363	374
6	203	403	416
7	224	444	458
8	244	485	500
9	265	526	542
10	285	566	584
11	306	607	626
12	326	648	668
13	347	689	710
14	367	729	752
15	388	770	794
16	408	811	836
17	429	851	878
18	449	892	920
19	470	933	962

ROCKETS @ 20.5 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 19 of 23)

M151 WARHEAD/M429 FUSE (10 POUND WARHEAD WITH PROXIMITY FUSE)

M260 LAUNCHER			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	35	70	72
1	56	111	115
2	77	152	157
3	97	194	200
4	118	235	242
5	139	276	285
6	160	317	327
7	181	359	370
M261 LAUNCHER			
0	80	159	164
1	101	200	207
2	122	241	249
3	142	283	292
4	163	324	334
5	184	365	377
6	205	406	419
7	226	448	462
8	246	489	504
9	267	530	547
10	288	571	589
11	309	613	632
12	333	654	674
13	350	695	717
14	371	736	759
15	392	778	802
16	413	819	844
17	434	860	887
18	454	901	929
19	475	943	972

ROCKETS @ 20.8 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 20 of 23)

M229 WARHEAD/M423 FUSE
(17 POUND WARHEAD WITH POINT DETONATING FUSE)

M260 LAUNCHER			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	35	70	72
1	63	124	127
2	91	177	183
3	119	231	238
4	147	285	294
5	175	339	349
6	202	392	405
7	230	446	460
M261 LAUNCHER			
0	80	159	164
1	108	213	219
2	136	266	275
3	164	320	330
4	192	374	386
5	220	428	441
6	247	481	496
7	275	535	552
8	303	589	607
9	331	642	663
10	359	696	718
11	387	750	774
12	415	803	829
13	443	857	
14	471	911	
15	499	965	
16	526	1018	
17	554	1072	
18	582	1126	
19	610	1179	

ROCKETS @ 27.9 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 21 of 23)

best copy available

M229 WARHEAD/M429 FUSE
(17 POUND WARHEAD WITH PROXIMITY FUSE)

M260 LAUNCHER			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	35	70	72
1	63	126	128
2	91	178	184
3	120	232	240
4	148	286	296
5	176	341	352
6	204	395	408
7	232	449	463
M261 LAUNCHER			
0	80	159	164
1	108	213	220
2	136	268	276
3	165	322	332
4	193	376	388
5	221	430	444
6	249	484	499
7	277	538	555
8	306	593	611
9	334	647	667
10	362	701	723
11	390	755	779
12	418	809	835
13	447	863	
14	475	918	
15	503	972	
16	531	1026	
17	559	1080	
18	588	1134	
19	616	1188	

ROCKETS @ 28.2 LBS. EACH

Figure 6-3. Folding fin aerial rocket (2.75 inch) moment table (Sheet 22 of 23)

WDU-4A/A (FLECHETTE) WARHEAD
(9.3 WARHEAD WITH DECELERATING ACTUATED FUSE)

M260 LAUNCHER			
Rockets (Number)	Weight (Pounds) Pod & No. of Rockets Indicated	LOCATION ON WING	
		Inboard Moment/100	Outboard Moment/100
0	35	70	72
1	55	110	113
2	75	150	154
3	96	190	196
4	116	230	237
5	136	270	278
6	156	310	320
7	176	350	361
M261 LAUNCHER			
0	80	159	164
1	100	199	205
2	120	239	247
3	141	279	288
4	161	319	329
5	181	359	371
6	201	400	412
7	221	440	453
8	242	480	494
9	262	520	536
10	282	560	577
11	302	600	618
12	322	640	660
13	343	680	701
14	363	720	742
15	383	760	783
16	403	800	825
17	423	840	866
18	444	880	907
19	464	920	949

ROCKETS @ 20.2 LBS. EACH

Figure 6-3. Holding fin aerial rocket (2.75 inch) moment table (Sheet 23 of 23)

7.62 MM (LINKED) FOR GAU-2B/A		
Rounds (Number)	Weight (Lbs) For No. of Rounds Indicated	Moment/100
250	16	21
500	33	42
750	49	63
1000	65	83
1250	81	103
1500	98	123
1750	114	142
2000	130	161
2250	146	179
2500	163	197
2750	179	215
3000	195	232
3250	211	250
3500	228	266
3750	244	283
4000	260	299

7.62MM AMMO (LINKED) @
0.065 LBS. EACH

40MM GRENADES FOR M129		
Rounds (Number)	Weight (Lbs) For No. of Rounds Indicated	Moment/100
25	19	21
50	38	43
75	57	64
100	76	86
125	95	107
150	114	129
175	133	150
200	152	172
225	171	193
250	190	215

GRENADES @ 0.76 LBS. EACH

7.62MM (LINKLESS) FOR M18

Rounds (Number)	Weight (Lbs) Pod & No. of Rounds Indicated	Inboard Wing Position (Only) Moment/100
0	245	481
100	251	492
200	256	503
300	262	514
400	267	526
500	273	537
600	278	548
700	284	559
800	289	570
900	295	581
1000	300	592
1100	306	603
1200	311	615
1300	317	626
1400	322	637
1500	328	648

7.62MM AMMO (LINKLESS) @
0.055 LBS. EACH

Figure 6-4. Ammunition moment table

BGM-71 OR BTM-71A TOW MISSILE

ITEM	WEIGHT (POUNDS)	OUTBOARD WING POSITION ONLY	
		UPPER LAUNCHER MOMENT/100	LOWER LAUNCHER MOMENT/100
(1) Launcher	60	123	122
(2) Launchers	120	246	244
(1) Tube	13	26	26
(2) Tubes	26	52	52
(3) Tubes	39	78	78
(4) Tubes	52	104	103
(1) Missile	41	82	82
(2) Missiles	82	164	163
(3) Missiles	123	246	245
(4) Missiles	164	328	326

Figure 6-5. TOW Missile moment table

WHITE SMOKE GRENADES IN XM118 POD		
Number	Weight (Lbs) Pod & No. of Grenades Indicated	Outboard Location Only Moment/100
0	17	33
1	19	37
2	21	40
3	22	43
4	24	47
5	26	50
6	28	54
7	29	57
8	31	61
9	33	65
10	35	69
11	36	72
12	38	76

WHITE SMOKE GRENADES @
1.75 LBS. EACH

COLORED SMOKE GRENADES IN XM118 POD		
Number	Weight (Lbs) Pod & No. of Grenades Indicated	Outboard Location Only Moment/100
0	17	33
1	18	35
2	19	37
3	20	39
4	21	41
5	22	43
6	23	45
7	24	47
8	25	49
9	26	51
10	27	54
11	28	56
12	29	58

COLORED SMOKE GRENADES @
1.0 LBS. EACH

Figure 6-6. Smoke grenede moment table

FUEL MOMENT
AH-1S

EXAMPLE

WANTED

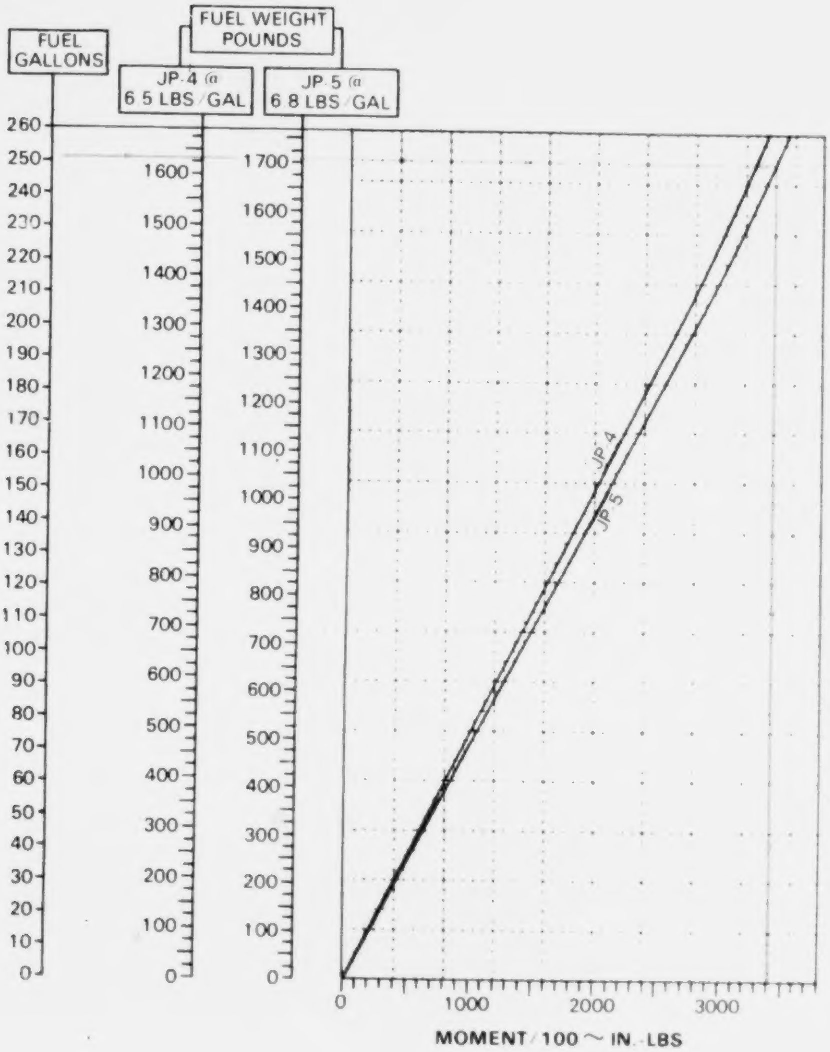
MOMENT FOR KNOWN FUEL QUANTITY

KNOWN

QUANTITY = 250 GALLONS OF JP-5

METHOD

MOVE RIGHT FROM 250 GALLONS (1700 LBS) TO INTERSECT DIAGONAL JP-5 LINE PROJECT DOWN AND READ, 3400 IN-LBS



209900-469A

Figure 6-7. Fuel moment chart

EXAMPLE

WANTED

DETERMINE APPROXIMATE CENTER OF GRAVITY FOR KNOWN WEIGHT AND MOMENT

KNOWN

GROSS WEIGHT = 9200 POUNDS
MOMENT/100 = 18150 INCH-POUNDS

METHOD

MOVE RIGHT FROM 9200 POUNDS TO APPROXIMATE MIDPOINT BETWEEN 18100 AND 18200 IN-LB DIAGONAL LINES
FROM THIS POINT MOVE DOWN TO READ 197.4 ON CENTER OF GRAVITY SCALE

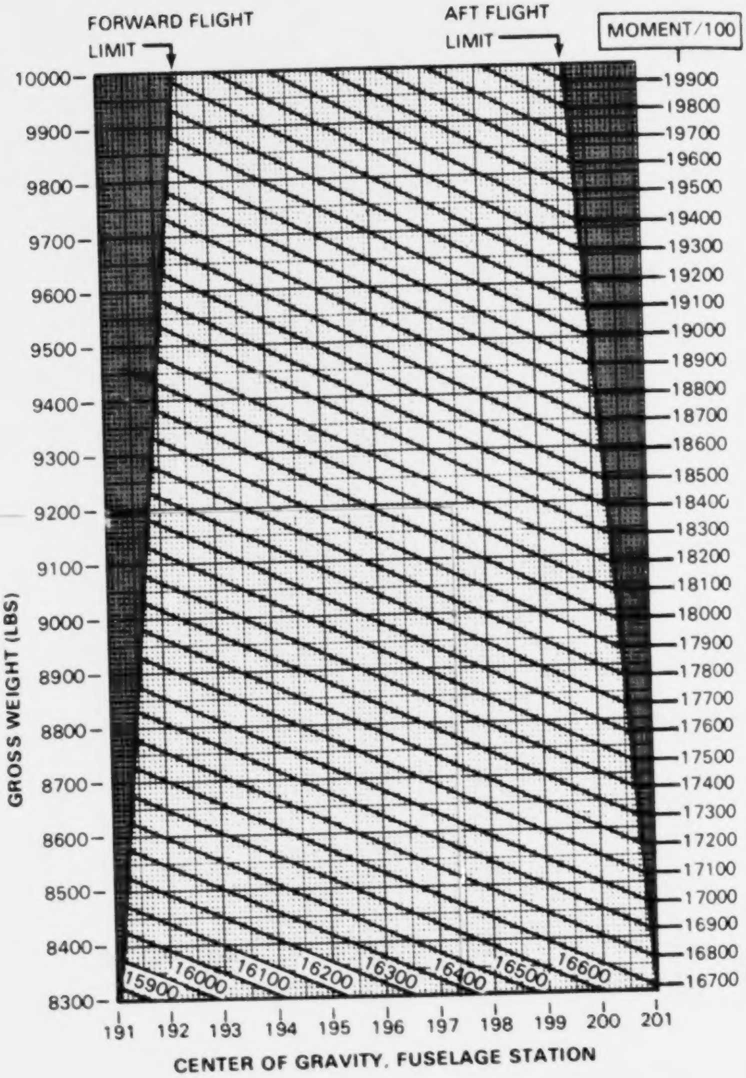


Figure 6-8. Center of gravity limit chart (Sheet 1 of 2)

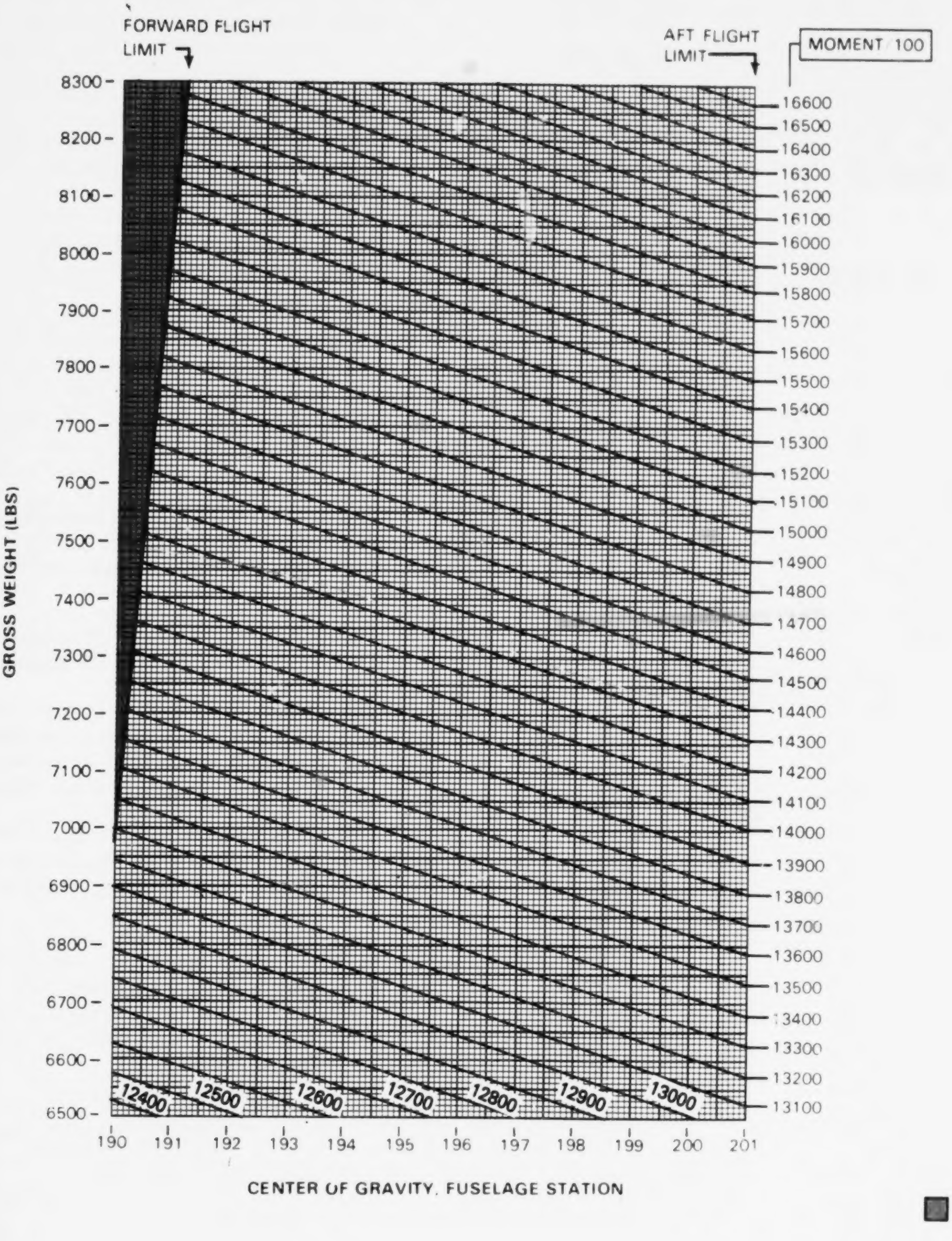


Figure 6-8. Center of gravity limit chart (Sheet 2 of 2)

Section VIII. DD FORM 365

All data on pages 6-16 through 6-20, including paragraphs 6-11 through 6-13 and figures 6-9 through 6-11, is deleted.

(12) Check the weight figure opposite reference 10 against the "Gross Weight Takeoff" in the "Limitations" table. Check the weight and moment/100 figures opposite reference 10 on figure 6-8 to ascertain that the cg is within the allowable limits.

(13) Reference 11 — if changes in amount of distribution of load are required, indicate necessary adjustments by proper entries in the "Corrections" table in lower left corner of the form as follows:

(a) Enter a brief description of the adjustment made in the column marked "Item".

(b) Add all the weight and moment decreases and insert the totals in the space opposite "Total Weight Removed".

(c) Add all the weight and moment increases and insert the totals in the space opposite "Total Weight Added".

(d) Subtract the smaller from the larger of the two totals and enter the difference (with applicable plus or minus sign) opposite "Net Difference".

(e) Transfer these net difference figures to the spaces opposite reference 11.

(14) Reference 12 — Enter the sum of, or the difference between, reference 10 and reference 11. Recheck to ascertain that these figures do not exceed allowable limits.

(15) Reference 13 — By referring to figure 6-8 determine the takeoff cg position. Enter this figure in the space provided opposite "Takeoff CG".

(16) Reference 14 — Estimate the weight of ammunition (not including weight of cases and links if retained), fuel, and any other items which may be expended before landing. Enter figures together with moment/100 in the spaces provided. To estimate the amount of fuel expended, perform the following calculation:

(a) Subtract the weight and moment of the fuel estimated to remain at landing from the weight and moment of the fuel loaded at takeoff.

(b) Enter the above result in section 14 of DD Form 365F.

EXAMPLE	GAL	WEIGHT	MOMENT
Fuel at takeoff	206	1400	2900
Fuel estimated to remain at landing		200	440

EXAMPLE	WEIGHT	MOMENT
Fuel expended (enter in section 14 of Form 365F)	1200	2460

NOTE

Do not consider reserve fuel as expended when determining ESTIMATED LANDING CONDITION.

(17) Reference 15 — Enter the difference in weights and moment/100 between reference 12 and the total of reference 14.

(18) Reference 16 — By again referring to figure 6-8, determine the estimated landing cg position. Enter the figure opposite "ESTIMATED LANDING CG".

(19) The necessary signatures must appear at the bottom of the form.

Page 6-18 Including Figure 6-9 deleted

CHAPTER 7

PERFORMANCE DATA

Section I. INTRODUCTION

7-1. Purpose.

The purpose of this chapter is to provide the best available performance data for the AH-1S helicopter. Regular use of this information will enable you to receive maximum safe utilization from the aircraft. Although maximum performance is not always required, regular use of this chapter is recommended for the following reasons.

a. Knowledge of your performance margin will allow you to make better decisions when unexpected conditions or alternate missions are encountered.

b. Situations requiring maximum performance will be more readily recognized.

c. Familiarity with the data will allow performance to be computed more easily and quickly.

d. Experience will be gained in accurately estimating the effects of variables for which data are not presented.

NOTE

The information provided in this chapter is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The data may also be used inflight, to establish unit or area standing operating procedures, and to inform ground commanders of performance/risk tradeoffs.

NOTE

All performance data presented in this chapter is based on operation with B540 main rotor blades installed. Data presented may be used when planning flights for aircraft equipped with K747 main rotor blads. Actual performance with K747 main rotor blades will be superior to that depicted on the charts.

7-2. Chapter 7 Index.

The following index contains a list of the sections and their titles, the figure numbers, subjects and page numbers of each performance data chart contained in this chapter.

Index

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II	Performance Planning	7-5
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	Figure 7-2 Temperature Conversion Chart	7-8
III	Power Available	7-9
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7-3. General.

The data presented covers the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, your judgment and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text accompanying each phase of performance. Where practical, data are presented at conservative conditions. However NO GENERAL CONSERVATISM HAS BEEN APPLIED. All performance data presented are within the applicable limits of the aircraft.

7-4. Limits.

Applicable limits are shown on the charts as red lines. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum value and time above limits on DA Form 2408-13 so proper maintenance action can be taken.

7-5. Use of Charts.

a. Chart Explanation. The first page of each section describes the chart(s) and explains its uses.

b. Color Coding. Chart color codes are used as follows.

(1) Green is used for example guidelines.

(2) Red is used for limit lines.

(3) Yellow is used for precautionary or time-limited operation.

c. Reading the Charts. The primary use of each chart is given in an example and a green guideline is provided to help you follow the route through the chart. The use of a straight edge (ruler or page edge) and a hard fine point pencil is recommended to avoid cumulative errors. The majority of the charts provide a standard pattern for use as follows: enter first variable on top left scale, move right to the second variable, reflect down at right angles to the third variable, reflect left at right angles to the fourth variable, reflect down, etc. until the final variable is read out at the final scale. In addition to the primary use, other uses of each chart are explained in the text accompanying each set of performance charts. Colored registration blocks located at the bottom and top of each chart are used to determine if slippage has occurred during printing. If slippage has occurred, refer to chapter 5 for correct operating limits.

NOTE

> An example of an auxiliary use of the charts referenced above is as follows: Although the hover chart is primarily arranged to find horsepower required to hover, by entering horsepower available as horsepower required, maximum skid height for hover can also be found. In general, any single variable can be found if all others are known. Also, the tradeoffs between two variables can be found. For example, at a given density altitude and pressure altitude, you can find the maximum gross weight capability as free air temperature changes.

The primary advantage of the helicopter over other aircraft is the capability to hover and takeoff and land vertically (zero air speed flight). To more readily calculate the performance trade-offs in hover mode, a Hover Ceiling Chart has been included.

d. Dashed Line Data. Data beyond conditions for which tests were conducted are shown as dashed lines.

7-6. Data Basis.

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The applicable report and date of the data are also given. The data provided generally is based on one of four categories:

a. Flight Test Data. Data obtained by flight test of the aircraft by experienced flight test personnel at precise conditions using sensitive calibrated instruments.

b. Derived From Flight Test. Flight test data obtained on a similar rather than the same aircraft and series. Generally small corrections will have been made.

c. Calculated Data. Data based on tests, but not on flight test of the complete aircraft.

d. · Estimated Data. Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7-7. Specific Conditions.

The data presented are accurate only for specific conditions listed under the title of each chart. Variables for which data are not presented, but which may affect that phase of performance, are discussed in the text. Where data are available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7-8. General Conditions.

In addition to the specific conditions, the following general conditions are applicable to the performance data.

a. Rigging. All airframe and engine controls are assumed to be rigged within allowable tolerances.

b. Pilot Technique. Normal pilot technique is assumed. Control movements should be smooth and continuous.

c. Aircraft Variation. Variations in performance between individual aircraft are known to exist; however, they are considered to be small and cannot be individually accounted for.

d. Instrument Variation. The data shown in the performance charts do not account for instrument inaccuracies or malfunctions.

7-9. Performance Discrepancies.

Regular use of this chapter will allow you monitor instruments and other aircraft system for malfunction, by comparing actu performance with planned performanc Knowledge will also be gained concerning th effects of variables for which data are n provided, thereby increasing the accuracy performance predictions.

7-10. Definitions of Abbreviations.

a. Unless otherwise indicated in the followin list of abbreviations, abbreviations and symbo used in this manual conform to those establishe in Military Standard MIL-STD-12, which periodically revised to reflect current changes abbreviations usage. Accordingly, it may be not that certain previously established definitio have been replaced by more current abbreviatio and symbols.

b. Capitalization and punctuation abbreviations varies, depending upon the conte in which they are used. In general, lower ca abbreviations are used in text material, where abbreviations used in charts and illustratio appear in full capital letters. Periods do not usual follow abbreviations; however, periods are us with abbreviations that could be mistaken f whole words if the period were omitted.

c. The following list provides definitions f abbreviations used in this manual. The sa abbreviation applies for either singular or plur applications.

LIST OF ABBREVIATIONS

Abbreviation	Definition	Abbreviation	Definition
AGL	Above ground level	F	Fahrenheit
ALT	Altitude	FAT	Free air temperature
AVAIL	Available	FLT	Flight
C	Celsius	FT	Foot
CAS	Calibrated airspeed	FT/MIN	Feet per minute
CL	Centerline	FWD	Forward
CONT	Continuous	Δ F	Increment of equivalent flat plate drag area
ECU	Environmental Control Unit		
END	Endurance	GAL	Gallon

LIST OF ABBREVIATIONS (Cont)

Abbreviation	Definition	Abbreviation	Definition
GAL/HR	Gallons per hour	NO.	Number
GRWT	Gross weight	NM	Nautical Mile
GW	Gross weight	PRESS	Pressure
HP	Horsepower	PSIG	Pounds per square inch gauge
HR	Hour	R/C	Rate of climb
IAS	Indicated airspeed	R/D	Rate of descent
IGE	In ground effect	RPM	Revolutions per minute
IN	Inch	SPEC	Specifications
IN HG	Inches of mercury	STA	Station
IR	Infrared	SQ FT	Square feet
KIAS	Knots indicated airspeed	TAS	True airspeed
KN	Knot	TOW	Tube launched optical guided wire controlled
°	Degree		
OGE	Out of ground effect	TRANS	Transmission
LB	Pound	USAASTA	United States Army Aviation Systems Test Activity
LB/HR	Pounds per hour		
MAX	Maximum	VDC	Volts, direct current
MIN	Minute	V_{NE}	Velocity, never exceed (airspeed limitation)
MIN	Minimum		
MM	Milimeter		

Section II. PERFORMANCE PLANNING

7-11. Performance Planning.

Refer to FC1-213 Aircrew Training Manual for preparing the performance planning card (PPC).

7-12. Temperature Conversion.

The temperature conversion chart (figure 7-2) is arranged so that degrees celsius can be converted quickly and easily by reading celsius and looking directly across the chart for fahrenheit equivalent and vice versa.

All data on pages 7-6 and 7-7, including figure 7-1 and paragraph 7-13 is deleted.

TEMPERATURE CONVERSION CHART

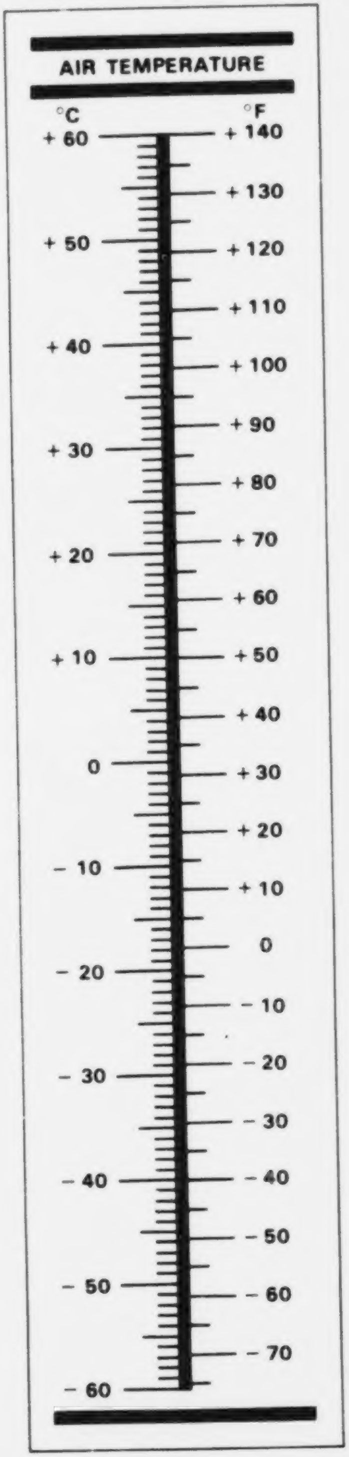


Figure 7-2. Temperature conversion chart

Section III. TORQUE AVAILABLE

7-14. Description.

The torque available charts show the effects of altitude and temperature on engine torque.

7-15. Chart Differences.

Both free air temperature (FAT) and pressure altitude affect engine power production. Figures 7-3 through 7-4 show power available data at both 30 minute power and maximum continuous power ratings in terms of the allowable torque as recorded by the torquemeter (PSIG).

Note that the power output capability of the T53-L-703 engine can exceed the transmission structural limit under certain conditions. Limits are shown on the chart (50 PSIG for normal or continuous operation and 56 PSIG for hover, takeoff and climb-30 minute limit).

a. Figure 7-3 is applicable for maximum power (always ECU off, 30-minute operation).

b. Figure 7-4 (sheet 1 of 2) is applicable for maximum continuous power with the ECU off.

c. Figure 7-4 (sheet 2 of 2) is applicable for continuous operation (ECU on). It should be noted that ECU on cost the equivalent of about 10°C FAT or approximately 10% power and 4% increase in fuel flow.

7-16. Use of Charts.

The primary use of the charts is illustrated by the examples. In general, to determine the maximum power available, it is necessary to know the pressure altitude and temperature. By entering the upper left side of the chart at the known pressure altitude, moving right to the known temperature, then straight down to the bottom of the lower grid, available torque is obtained.

7-17. Conditions.

Charts are based upon speeds of 324 rotor/6600 engine rpm with grade JP-4 fuel. The use of higher octane grade aviation gasoline will not influence engine power. Fuel grade of JP-5 will yield the same nautical miles per pound of fuel and being 6.8 pounds per gallon will only result in increased fuel capacity.

Section IV. HOVER

7-18. Description.

The hover chart (figure 7-5) shows the torque required to hover at various pressure altitudes, ambient temperatures, gross weights, and skid heights. Maximum skid height for hover can also be obtained by using the torque available from figure 7-3.

7-19. Use of Chart.

a. The primary use of the chart is illustrated by the chart example. In general, to determine the torque required to hover, it is necessary to know the pressure altitude, temperature, gross weight and the desired skid height.

b. In addition to its primary use, the hover chart can also be used to determine the predicted maximum hover height, which is needed for use of the takeoff chart (figure 7-6). To determine maximum hover height, proceed as follows.

(1) Enter chart at appropriate pressure altitude.

(2) Move right to FAT.

(3) Move down to gross weight.

(4) Move left to intersection with maximum power available (obtained from figure 7-3).

(5) Read predicted maximum skid height. This freight is the maximum hover height.

7-19A. Control Margin.

Ten percent pedal margin is considered adequate for safe directional control. The rearward airspeed limit is 30 knots and sideward limit is 35 knots except that directional control is marginal for certain combinations of relative wind velocity and azimuth angles (measured clockwise from the nose of the helicopter). Figure 7-5A shows the combinations of relative wind velocity and azimuth which may result in marginal directional control. Figure 7-5A (sheet 1) shows the maximum right crosswind, in knots true airspeed, which one can achieve and still maintain 10 percent directional control margin for given gross weights and density altitudes. This figure has zone letters which are to be used in conjunction with figure 7-5A (sheet 2). If, for example, your operating gross weight and density altitude are such that the point lies in zone C on sheet 1 then go to sheet 2. The zone identified by the letter C shows the wind velocity in knots that one can achieve while still maintaining a 10 percent directional control margin (e.g. if the wind were from 45 degrees you could have 22 knots of wind whereas if from 60 degrees only 15.4 knots). The left vertical zone lines on sheet 2 represent 10 percent control margin. As you move toward the right vertical line, for that gross weight and density altitude, the control margin approaches zero.

7-20. Conditions.

The hover chart is based upon calm wind conditions, a level ground surface, and the use of 324 rotor/6600 engine rpm.

a. Deleted.

b. Ground Surface. In ground effect hover data is based upon hovering over a level surface. If the surface over which hovering will be conducted is known to be steep, uneven, covered with high vegetation, of if the type of terrain is unknown, the flight should be planned for out of ground effect hover capability.

Section V. TAKEOFF

7-21. Description.

The takeoff chart (figure 7-6) shows the distances to clear various obstacle heights, based upon several hover height capabilities. The upper chart grid presents data for climbout at a constant 35 knots INDICATED airspeed. The two lower grids present data for climbouts at varous TRUE airspeeds.

NOTE

The hover heights shown on the chart are only a measure of the aircraft's climb capability and do not imply that a higher than normal hover height should be used during the actual takeoff.

7-22. Use of Chart.

The primary use of the chart is illustrated by the chart examples. The main consideration for takeoff performance is the hovering skid height capability, which includes the effects of pressure altitude, free air temperature, gross weight, and torque. Hover height capability is determined by use of the hover chart, figure 7-5. A hover check can be made to verify the hover capability. If winds are present, the hover check may disclose that the helicopter can actually hover at a greater skid height than the calculated value, since the hover chart is based upon calm wind conditions.

7-23. Conditions.

a. Wind. The takeoff chart is based upon calm wind conditions. Since surface wind velocity and direction cannot be accurately predicted, all takeoff planning should be based upon calm wind conditions. Takeoff into any prevailing wind will improve the takeoff performance.

WARNING

A tailwind during takeoff and climbout will increase the obstacle clearance distance and could prevent a successful takeoff.

b. Power Settings. All takeoff performance data are based upon the torque used in determining the hover capabilities in figure 7-5.

Section VI. CLIMB PERFORMANCE

7-24. Deleted.

7-25. Deleted.

7-26. Deleted.

MAXIMUM TORQUE AVAILABLE (30 MINUTE OPERATION)

ANTI-ICE OFF ECU OFF PARTICLE SEPARATOR INSTALLED
324 ROTOR/6600 ENGINE RPM JP-4 FUEL INSTALLATION LOSSES INCLUDED

MAXIMUM TORQUE
AH-1S
T53-L-703

EXAMPLE

WANTED

CALIBRATED TORQUE

KNOWN

PRESSURE ALTITUDE = 7000 FEET
FAT = 20°C

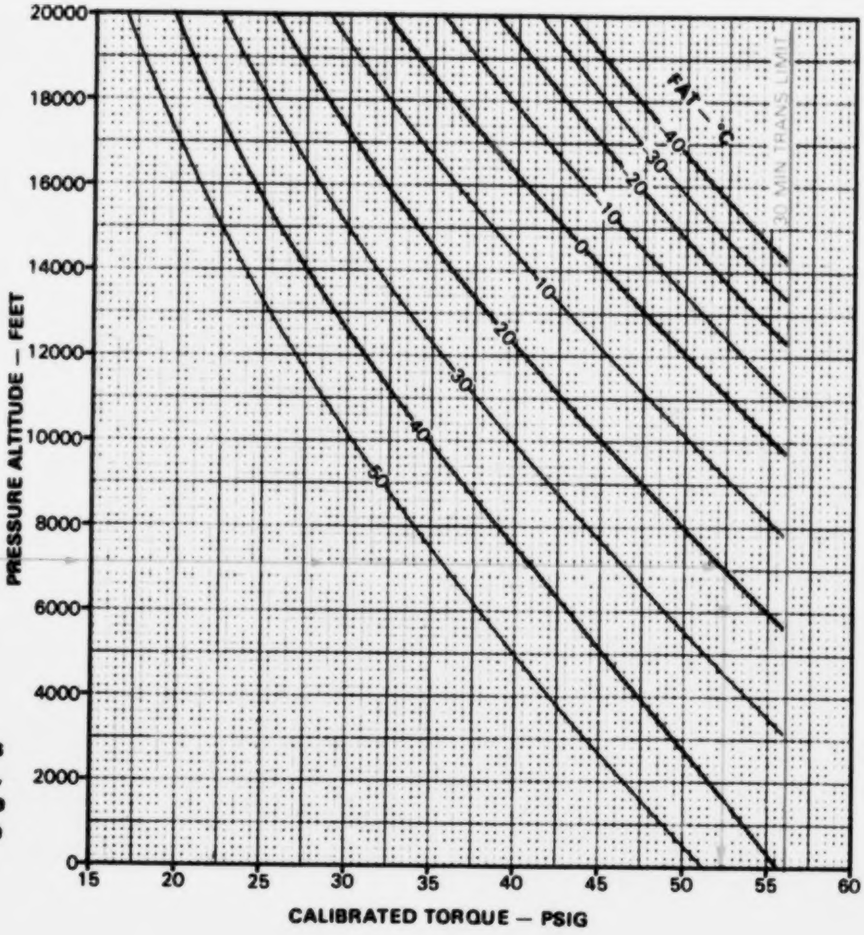
METHOD

ENTER PRESSURE ALTITUDE HERE

MOVE DOWN, READ
CALIBRATED TORQUE = 52.5 PSIG

NOTE

Prolonged IGE hover increases engine inlet temperature, therefore a higher FAT must be used to correct for the increase under this condition.



DATA BASIS: CALCULATED FROM MODEL SPEC 104.43, 1 MAY 1974. CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST, USA ASTA 66-06, APRIL 1970

Figure 7-3. Maximum torque available (30 minute operation) chart

TORQUE AVAILABLE (CONTINUOUS OPERATION)

TORQUE AVAILABLE
AH-1S
T53-L-703

ANTI-ICE OFF   ECU OFF   PARTICAL SEPARATOR INSTALLED
324 ROTOR/6600 ENGINE RPM   JP-4 FUEL   INSTALLATION LOSSES INCLUDED

EXAMPLE

WANTED

CALIBRATED TORQUE

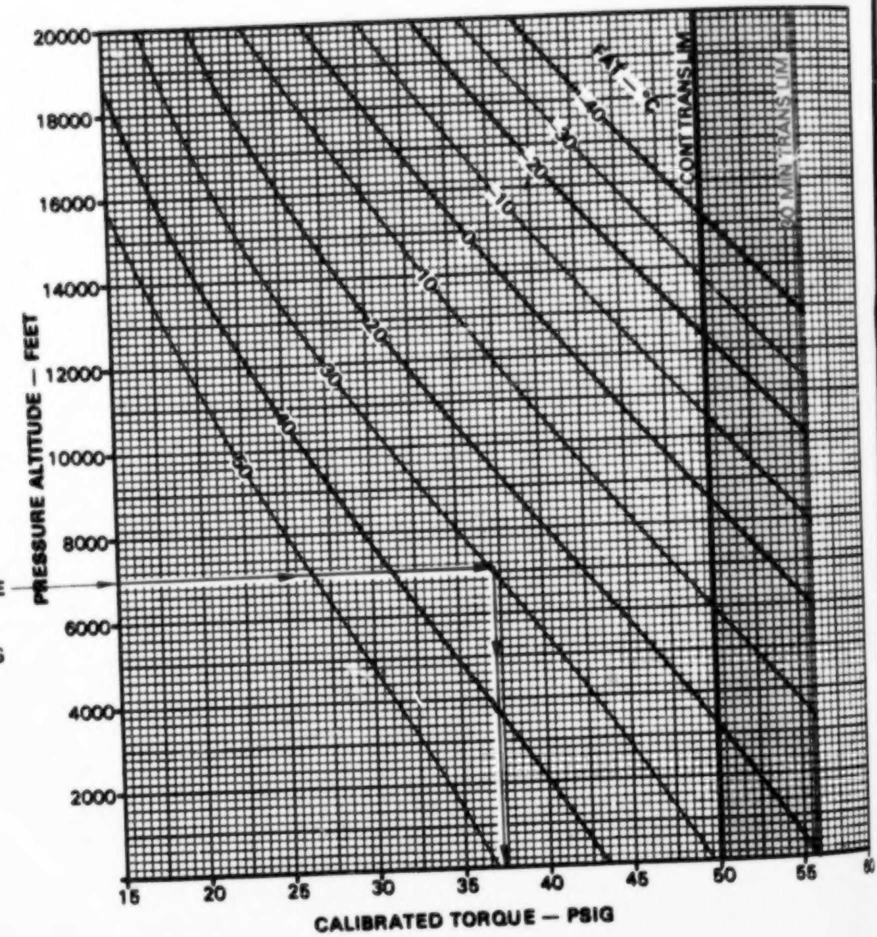
KNOWN

PRESSURE ALTITUDE = 7000 FEET
FAT = 30°C

METHOD

ENTER PRESSURE ALTITUDE HERE

MOVE DOWN, READ
CALIBRATED TORQUE = 37.0 PSIG



DATA BASIS: CALCULATED FROM MODEL SPEC 104.43, 1 MAY 1974. CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST, USA ASTA 66-06, APRIL 1970

Figure 7-4. Torque available (Continuous operation) chart (Sheet 1 of 2)

TORQUE AVAILABLE (CONTINUOUS OPERATION)

ANTI-ICE OFF ECU ON PARTICAL SEPARATOR INSTALLED

324 ROTOR/6600 ENGINE RPM JP-4 FUEL INSTALLATION LOSSES INCLUDED

TORQUE AVAILABLE
AH-1S
T53-L-703

EXAMPLE

WANTED

CALIBRATED TORQUE

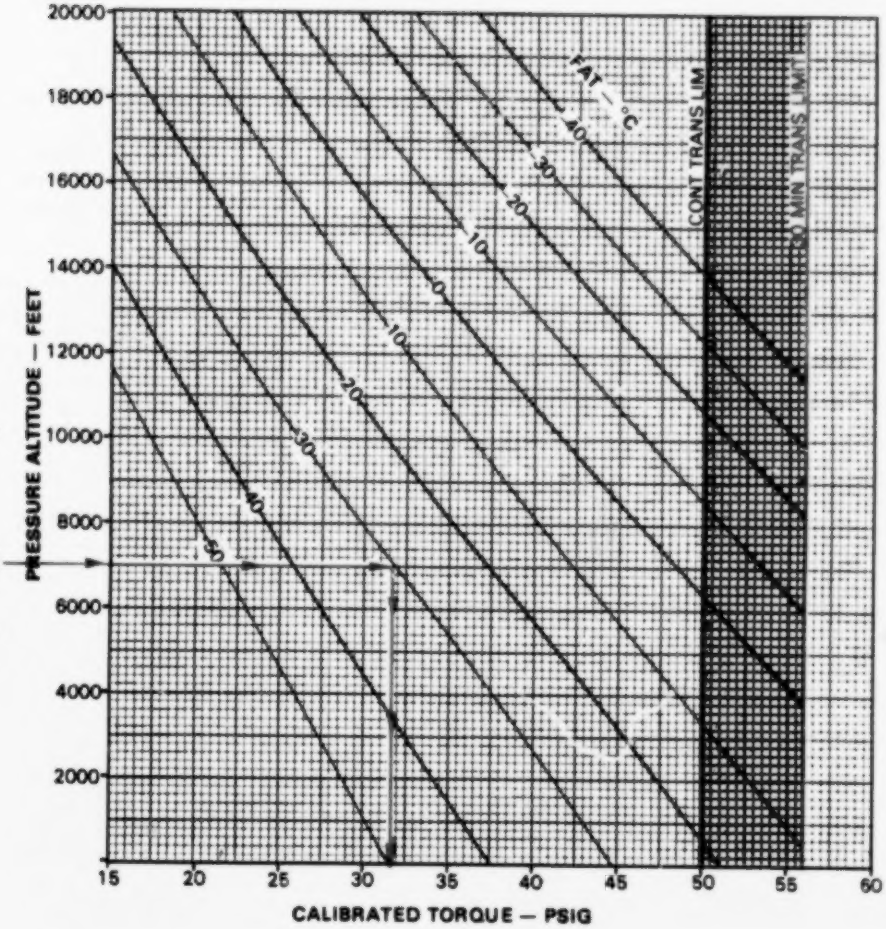
KNOWN

PRESSURE ALTITUDE = 7000 FEET
FAT = 30°C

METHOD

ENTER PRESSURE ALTITUDE HERE

MOVE DOWN, READ
CALIBRATED TORQUE = 31.8 PSIG



DATA BASIS: CALCULATED FROM MODEL SPEC 104.43, 1 MAY 1974. CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST, USA ASTA 66-06, APRIL 1970

Figure 7-4. Torque available (Continuous operation) chart (Sheet 2 of 2)

HOVER

ALL CONFIGURATIONS 324 ROTOR/6600 ENGINE RPM
LEVEL SURFACE CALM WIND

HOVER
AH-1S
T53-L-703

EXAMPLE

WANTED

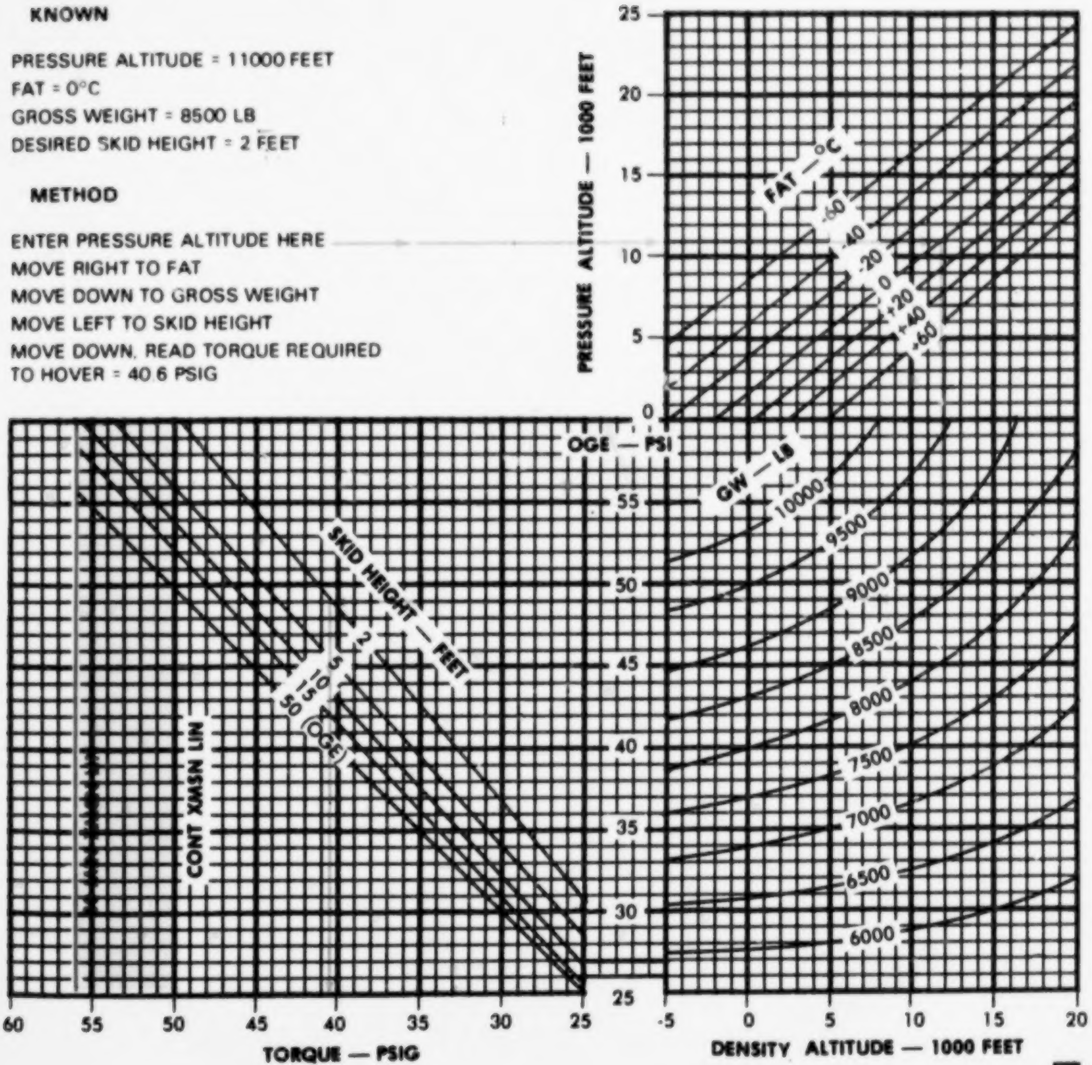
TORQUE REQUIRED TO HOVER

KNOWN

PRESSURE ALTITUDE = 11000 FEET
FAT = 0°C
GROSS WEIGHT = 8500 LB
DESIRED SKID HEIGHT = 2 FEET

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO FAT
MOVE DOWN TO GROSS WEIGHT
MOVE LEFT TO SKID HEIGHT
MOVE DOWN, READ TORQUE REQUIRED
TO HOVER = 40.6 PSIG



DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 66-06, APRIL 1970

Figure 7-5. Hover (Torque required) chart

DIRECTIONAL CONTROL MARGIN

CONTROL
MARGIN
AH-1S
T53-L-703

EXAMPLE

WANTED

CONDITIONS (AIRSPEED — AZIMUTH) WHERE DIRECTIONAL CONTROL MARGIN MAY BE LESS THAN 10%

KNOWN

PRESSURE ALTITUDE = 5000 FEET
FAT = 0°C
GROSS WEIGHT = 8500 POUNDS

METHOD

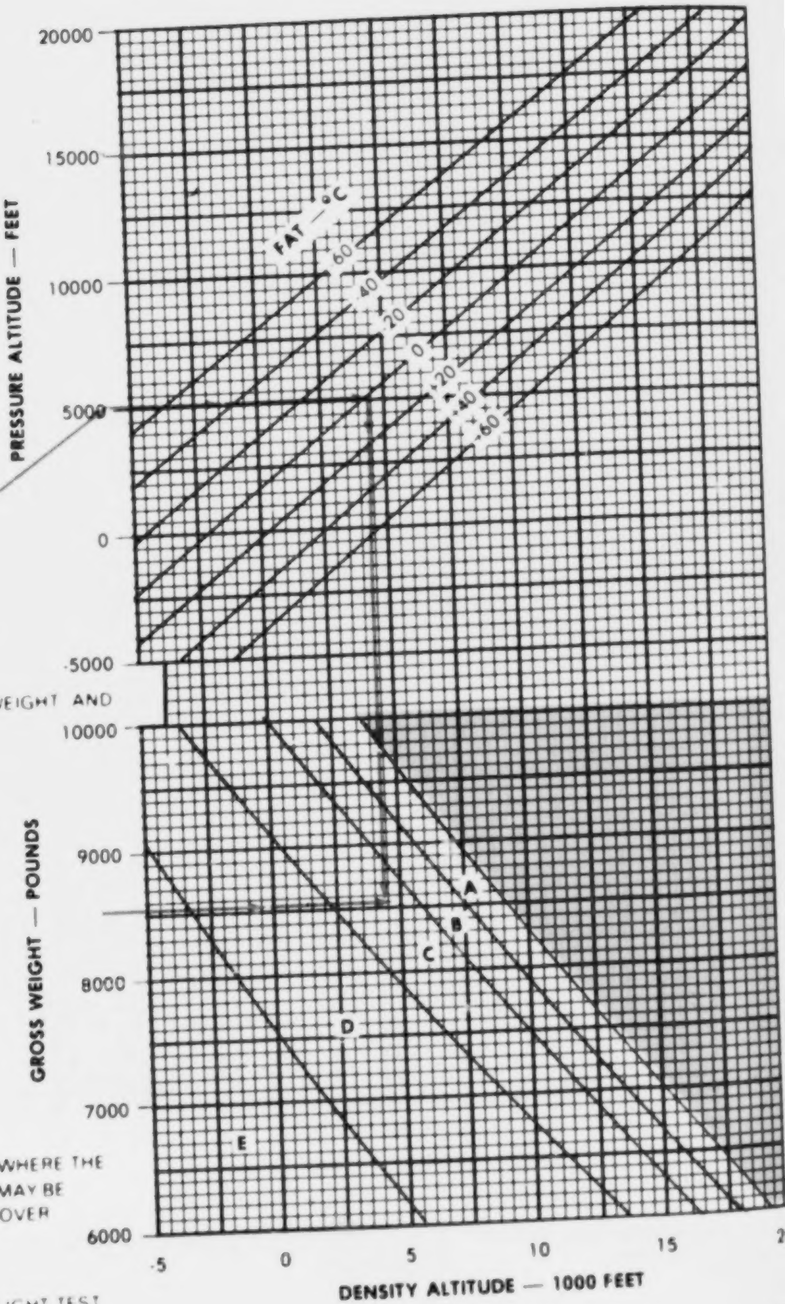
ENTER PRESSURE ALTITUDE HERE

MOVE RIGHT TO FAT

MOVE DOWN TO KNOWN GROSS WEIGHT

DETERMINE INTERSECTION OF GROSS WEIGHT AND DENSITY ALTITUDE LINES IS IN AREA C

REFER TO SHEET 2
DIRECTIONAL CONTROL MARGIN MAY BE LESS THAN 10% FOR THE CONDITIONS (AIRSPEED & AZIMUTH)



☐ YELLOW INDICATES CONDITIONS WHERE THE DIRECTIONAL CONTROL MARGIN MAY BE LESS THAN 10% IN ZERO WIND HOVER

DATA BASIS DERIVED FROM FLIGHT TEST

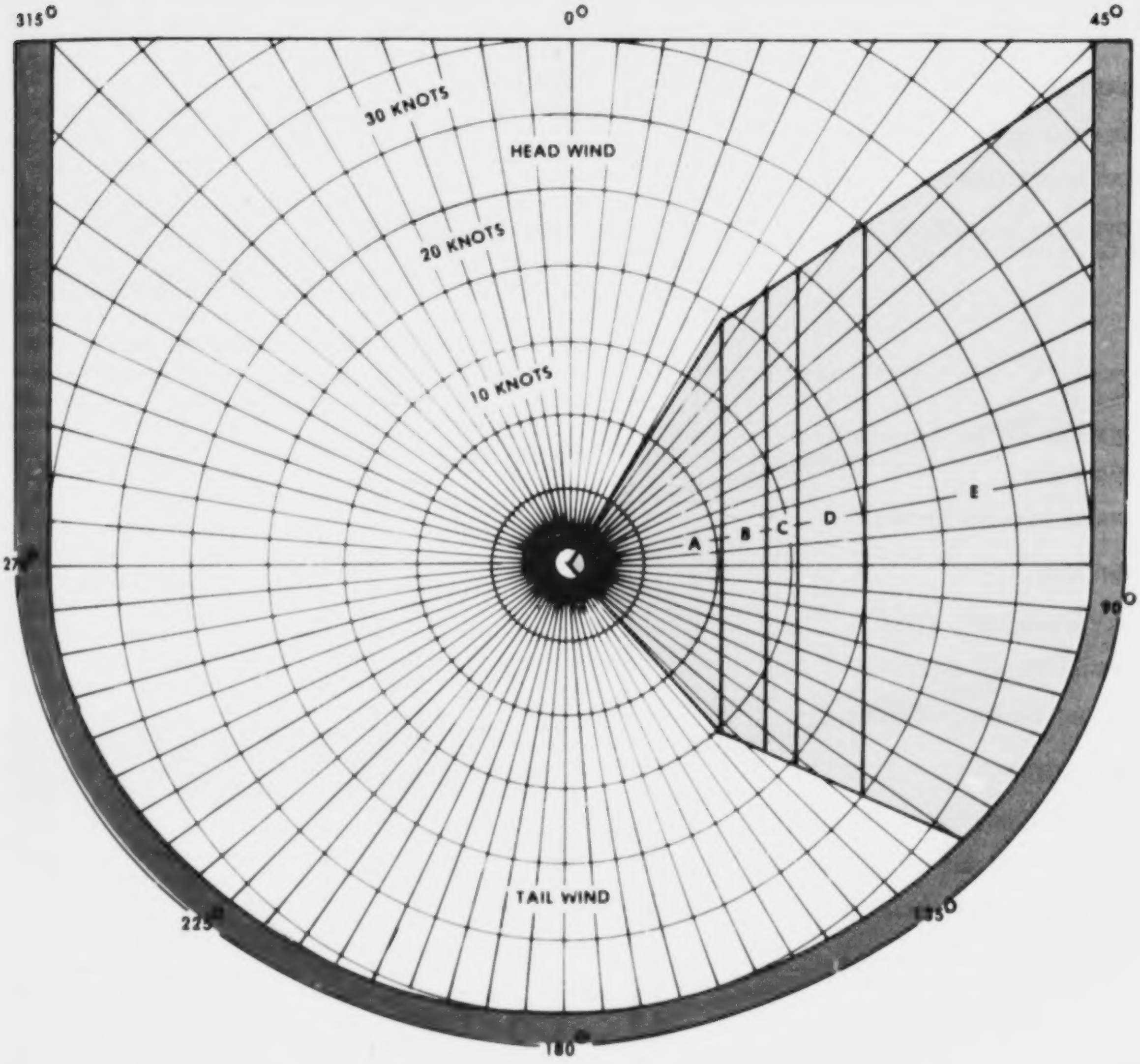
Figure 7-5A. Directional Control Margin Chart (Sheet 1 of 2

DIRECTIONAL CONTROL MARGIN

CONTROL
MARGIN
AH 1S
T53 L 703

☐ YELLOW INDICATES CONDITIONS WHERE THE DIRECTIONAL CONTROL MARGIN MAY BE LESS THAN 10%. SEE SHEET 1 FOR GROSS WEIGHTS AND ALTITUDES CORRESPONDING TO AREAS A, B,C,D, AND E.

■ RED INDICATES AIRSPEED LIMITS



DATA BASIS: DERIVED FROM FLIGHT TEST

Figure 7-5A. Directional Control Margin Chart (Sheet 2 of 2)

TAKEOFF

LEVEL ACCELERATION TECHNIQUE 2 FT SKID HEIGHT
324 ROTOR/6600 ENGINE RPM MAXIMUM TORQUE AVAILABLE
ALL CONFIGURATIONS CALM WIND

TAKEOFF
AH-1S
T53-L-703

EXAMPLE A

WANTED

DISTANCE TO CLEAR OBSTACLE

KNOWN

MAXIMUM HOVER HEIGHT = 10 FEET
OBSTACLE HEIGHT = FEET

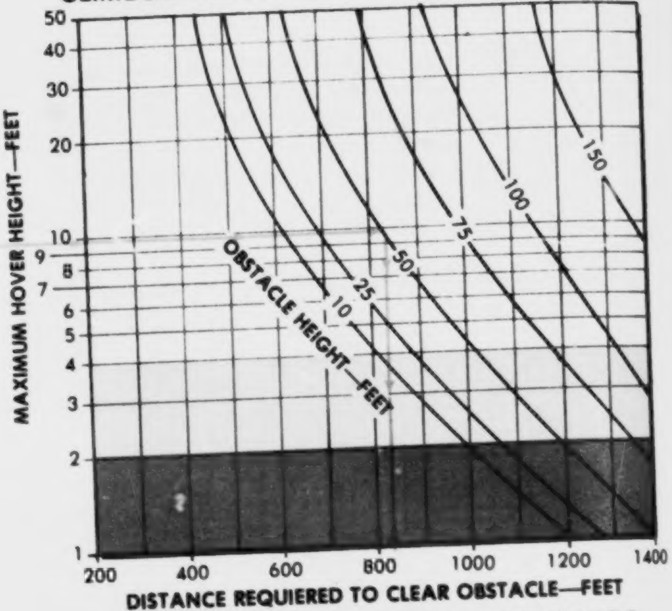
METHOD

ENTER MAX HOVER HEIGHT HERE

MOVE RIGHT TO OBSTACLE HEIGHT

MOVE DOWN, READ DISTANCE TO CLEAR OBSTACLE = 825 FEET

CLIMBOUT AT 35 KNOTS INDICATED AIRSPEED



EXAMPLE B

WANTED

DISTANCE TO CLEAR OBSTACLE

KNOWN

MAX HOVER HEIGHT = 8 FEET

OBSTACLE HEIGHT = 50 FEET

CLIMBOUT AIRSPEED = 40 KNOTS

METHOD

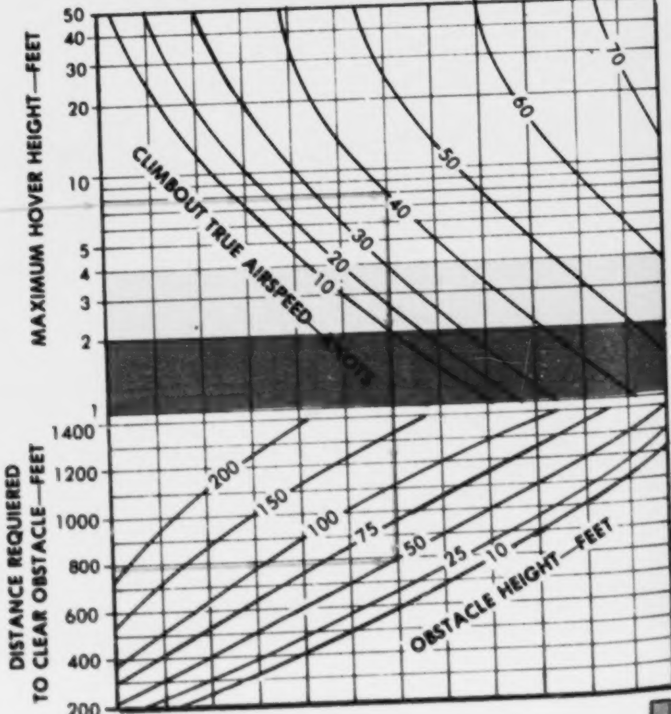
ENTER MAX HOVER EHIGHT HERE

MOVE RIGHT TO CLIMBOUT TRUE AIRSPEED

MOVE DOWN TO OBSTACLE HEIGHT

MOVE LEFT READ DISTANCE TO CLEAR OBSTACLE = 800 FEET

CLIMBOUT AT VARIOUS TRUE AIRSPEEDS



DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 66-06, APRIL 1970

Figure 7-6. Takeoff chart

CLIMB PERFORMANCE (MAXIMUM TORQUE -30 MINUTE OPERATION)

324 ROTOR/6600 ENGINE RPM CLIMB AT 60 KIAS

EXAMPLE

WANTED

MAXIMUM POWER
TIME TO CLIMB
DISTANCE TRAVELED
FUEL USED

KNOWN

GROSS WEIGHT = 8700 LBS
INITIAL PRESSURE ALTITUDE = 2000 FT
FINAL PRESSURE ALTITUDE = 6000 FT
INITIAL FAT = 40°C
FINAL FAT ESTIMATED AT 40°C

METHOD

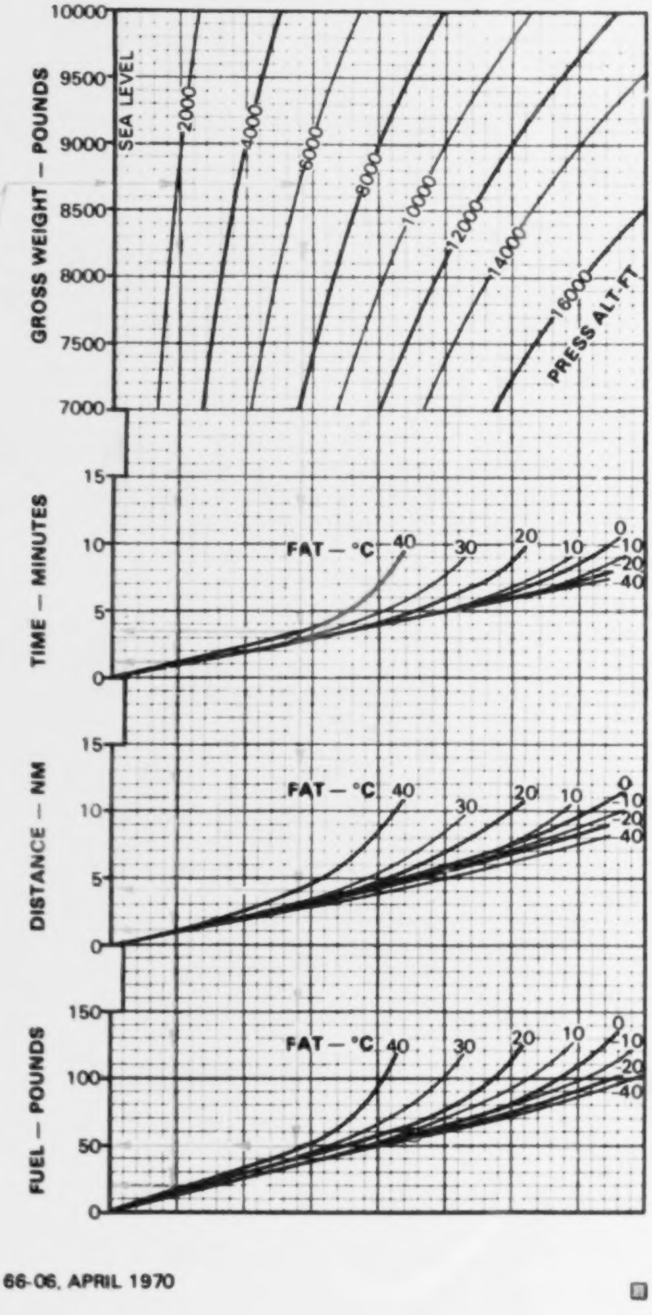
ENTER GROSS WEIGHT HERE
MOVE RIGHT TO INITIAL PRESSURE ALTITUDE
MOVE DOWN TO INITIAL FAT ON TIME, DISTANCE, AND FUEL CHARTS
MOVE LEFT, READ:

TIME	=	1.2 MIN
DISTANCE	=	1.0 NM
FUEL	=	17 LB

REENTER AT SAME GROSS WEIGHT
MOVE RIGHT TO FINAL PRESSURE ALTITUDE
MOVE DOWN TO FINAL FAT, ON TIME, DISTANCE, AND FUEL CHARTS
MOVE LEFT, READ:

TIME	=	3.5 MIN
DISTANCE	=	4.1 NM
FUEL	=	47 LB

TIME TO CLIMB = (3.5 - 1.2) = 2.3 MIN
DISTANCE COVERED = (4.1 - 1.0) = 3.1 NM
FUEL USED = (47 - 17) = 30 LB



DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 66-06, APRIL 1970

Figure 7-7. Climb performance (Maximum torque — 30 minute operation) chart

Section VII. CRUISE

7-27. Description.

The cruise charts (figure 7-8, sheet 1 through 24) show the torque pressure and engine rpm required for level flight at various pressure altitudes, airspeeds and gross weights.

NOTE

> The cruise charts are basically arranged by drag configuration groupings. Figures 7-8 sheets 1 through 12 are based upon operation with 4 TOW missiles. Figure 7-8, sheets 13 through 24, present equivalent information for operation with 8 TOW missiles.

7-28. Use of Charts.

The primary use of the charts is illustrated by the examples provided in figure 7-8. The first step for chart use is to select the proper chart, based upon the planned drag configuration, pressure altitude and anticipated free air temperature: refer to chapter 7 index (paragraph 7-2). Normally, sufficient accuracy can be obtained by selecting the chart nearest to the planned cruising altitude and FAT, or the next higher altitude and FAT (chart Example A, Method 1). If greater accuracy is required, interpolation between altitudes and or temperatures will be required (chart Example A, Method 2). You may enter the charts on any side: TAS, IAS, torque pressure, or fuel flow, and then move vertically or horizontally to the gross weight, then to the other three parameters. Maximum performance conditions are determined by entering the chart where the maximum range or maximum endurance and rate of climb lines intersect the appropriate gross weight: then read airspeed, fuel flow and torque pressure. For conservatism, use the gross weight at the beginning of cruise flight. For greater accuracy on long flights it is preferable to determine cruise information for several flight segments in order to allow for decreasing fuel weight (reduced gross weight). The following parameters contained in each chart are further explained as follows.

a. Airspeed. True and indicated airspeeds are presented at opposite sides of each chart. On any chart, indicated airspeed can be directly converted to true airspeed (or vice versa) by reading directly across the chart without regard for other chart information. Maximum permissible airspeed (V_{NE}) limits appear as red lines on some charts. If no red line appears, V_{NE} is above the limits of the chart.

b. Torque Pressure. Since pressure altitude and temperature are fixed for each chart, torque pressures vary according to gross weight and airspeed.

c. Fuel Flow. Fuel flow scales are provided opposite the torque pressure scales. On any chart, torque pressure may be converted directly to fuel flow without regard for other chart information. All fuel flow information is presented ECU off. Add 4% fuel flow for ECU on.

d. Maximum Range. The maximum range lines indicate the combinations of weight and airspeed that will produce the greatest flight range per gallon of fuel under zero wind conditions. When a maximum range condition does not appear on a chart it is because the maximum range speed is beyond the maximum permissible speed (V_{NE}); in such cases, use V_{NE} cruising speed to obtain maximum range.

e. Maximum Endurance and Rate of Climb. The maximum endurance and rate of climb lines indicate the airspeed for minimum torque pressure required to maintain level flight for each gross weight, FAT and pressure altitude. Since minimum torque pressure will provide minimum fuel flow, maximum flight endurance will be obtained at the airspeeds indicated.

7-29. Conditions.

The cruise charts are based upon operation at 324 rotor 6600 engine speeds.

a. The charts are based on ECU off.

b. The fuel flow increases approximately 4% with ECU on.

EXAMPLE A

WANTED

TORQUE REQUIRED FOR LEVEL FLIGHT, FUEL FLOW, INDICATED AIRSPEED

KNOWN

4 TOW CONFIGURATION
GROSS WEIGHT = 10000 LB
PRESSURE ALTITUDE = 1000 FEET
FAT = -30°C
DESIRED TRUE AIRSPEED = 120 KNOTS

METHOD 1 (SIMPLEST)

USE NEXT HIGHEST ALTITUDE AND/OR TEMPERATURE (2000 FEET, -30°C)
ENTER TRUE AIRPSEED AT 120 KNOTS → ①
MOVE RIGHT TO GROSS WEIGHT
MOVE DOWN, READ CALIBRATED TORQUE = 43.0 PSIG
MOVE UP, READ FUEL FLOW = 648 LB/HR
MOVE RIGHT, READ IAS = 130 KNOTS

METHOD 2 (INTERPOLATE)

READ TORQUE, FUEL FLOW, AND IAS ON EACH ADJACENT ALTITUDE AND/OR FAT, THEN INTERPOLATE BETWEEN ALTITUDE AND FAT

ALTITUDE	SEA LEVEL	2000 FEET	1000 FEET
FAT -°C	-30	-30	-30
TORQUE, PSIG	44.5	43.0	43.8
FUEL FLOW, LB/HR	678	648	663.0
IAS, KNOTS	135	130	132.5

EXAMPLE B

WANTED

SPEED FOR MAXIMUM RANGE
SPEED FOR MAXIMUM ENDURANCE

KNOWN

4 TOW CONFIGURAION
GROSS WEIGHT = 10000 LB
PRESSURE ALTITUDE = 4000 FEET
FAT = -30°C

METHOD

LOCATE (4000 FEET, -30°C) CHART
FIND INTERSECTION OF 10000 LB GROSS WEIGHT LINE
WITH THE MAXIMUM RANGE LINE → ②
TO READ SPEED FOR MAXIMUM RANGE:
  MOVE LEFT, READ TAS = 130 KNOTS AND
  MOVE RIGHT, READ IAS = 136 KNOTS
FIND INTERSECTION OF 10000 LB GROSS WEIGHT LINE
WITH THE MAXIMUM ENDURANCE LINE → ③
TO READ SPEED FOR MAXIMUM ENDURANCE:
  MOVE LEFT, READ TAS = 68.5 KNOTS AND
  MOVE RIGHT, READ IAS = 68.0 KNOTS

DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 66-06, APRIL 1970;
MODEL SPEC 104.43, 1 MAY 1974

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CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

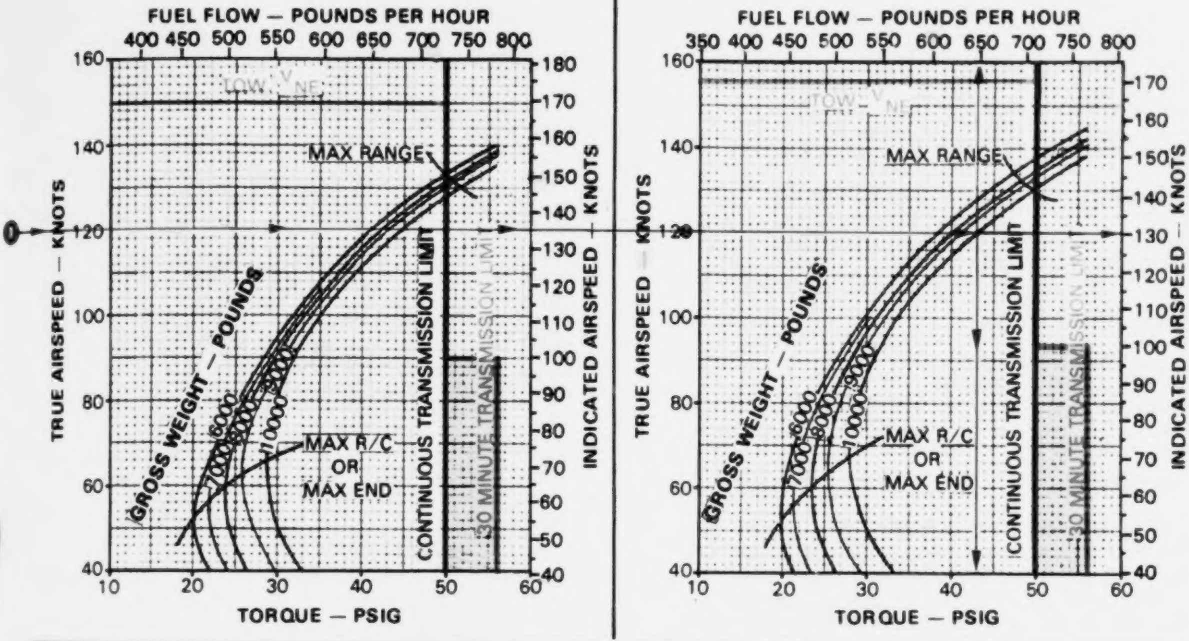
JP-4 FUEL OGE

FAT = -30°C

CRUISE
AH-1S
T53-L-703

PRESSURE ALTITUDE — SEA LEVEL

PRESSURE ALTITUDE — 2000 FEET



PRESSURE ALTITUDE — 4000 FEET

PRESSURE ALTITUDE — 6000 FEET

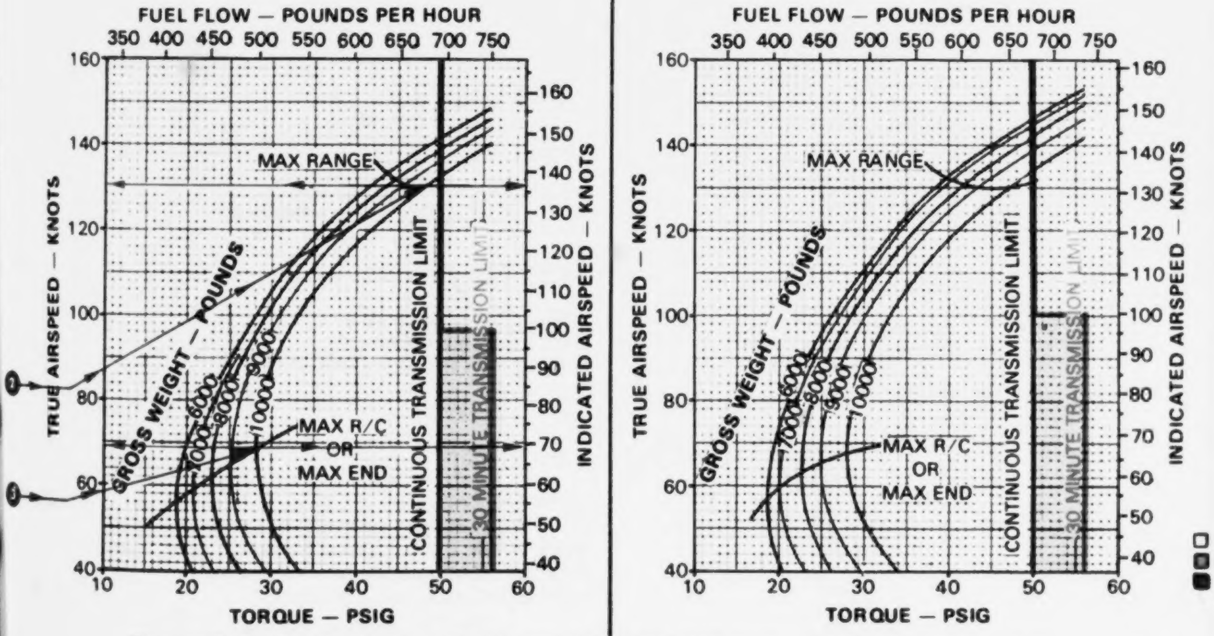


Figure 7-8. Cruise chart, 4 TOW, sea level to 6000 feet, -30°C (Sheet 1 of 24)

EXAMPLE C

WANTED

EXCESS TORQUE AVAILABLE FOR CLIMB AT
MAXIMUM CONTINUOUS POWER

KNOWN

4 TOW CONFIGURATION
GROSS WEIGHT = 10000 LB
PRESSURE ALTITUDE = 8000 FEET
FAT = -30°C

METHOD

LOCATE (8000 FEET, -30°C) CHART
FIND INTERSECTION OF 10000 LB GROSS WEIGHT LINE
WITH THE MAXIMUM RATE OF CLIMB LINE
MOVE DOWN, READ TORQUE REQUIRED = 29 PSIG
FIND INTERSECTION OF 10000 LB GROSS WEIGHT LINE
WITH THE CONTINUOUS TRANSMISSION LIMIT LINE
MOVE DOWN, READ TORQUE AVAILABLE = 50 PSIG
EXCESS TORQUE AVAILABLE = (50 -29) = 21 PSIG

EXAMPLE D

WANTED

SPEED FOR MAXIMUM RANGE,
TORQUE REQUIRED AND FUEL FLOW AT
MAXIMUM RANGE

KNOWN

4 TOW CONFIGURATION
GROSS WEIGHT = 9000 LB
PRESSURE ALTITUDE = 10000 FEET
FAT = -30°C

METHOD

LOCATE (10000 FEET, -30°C) CHART
FIND INTERSECTION OF 9000 LB GROSS WEIGHT LINE
WITH THE MAXIMUM RANGE LINE
TO READ SPEED FOR MAXIMUM RANGE:
  MOVE LEFT, READ TAS = 131 KNOTS AND
  MOVE RIGHT, READ IAS = 122 KNOTS
TO READ TORQUE REQUIRED:
  MOVE DOWN, READ TORQUE = 43 PSIG
TO READ FUEL FLOW REQUIRED:
  MOVE UP, READ FUEL FLOW = 580 LB/HR

EXAMPLE E

WANTED

CALIBRATED TORQUE REQUIRED,
FUEL FLOW AND INDICATED AIRSPEED

KNOWN

4 TOW CONFIGURATION
GROSS WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12000 FEET
FAT = -30°C
TAS = 110 KNOTS

METHOD

ENTER TAS LINE HERE
MOVE RIGHT TO INTERSECTION OF GROSS WEIGHT
MOVE DOWN, READ TORQUE REQUIRED = 34.1 PSIG
MOVE UP, READ FUEL FLOW = 470 LB/HR
MOVE RIGHT, READ IAS = 97 KIAS

CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = -30°C

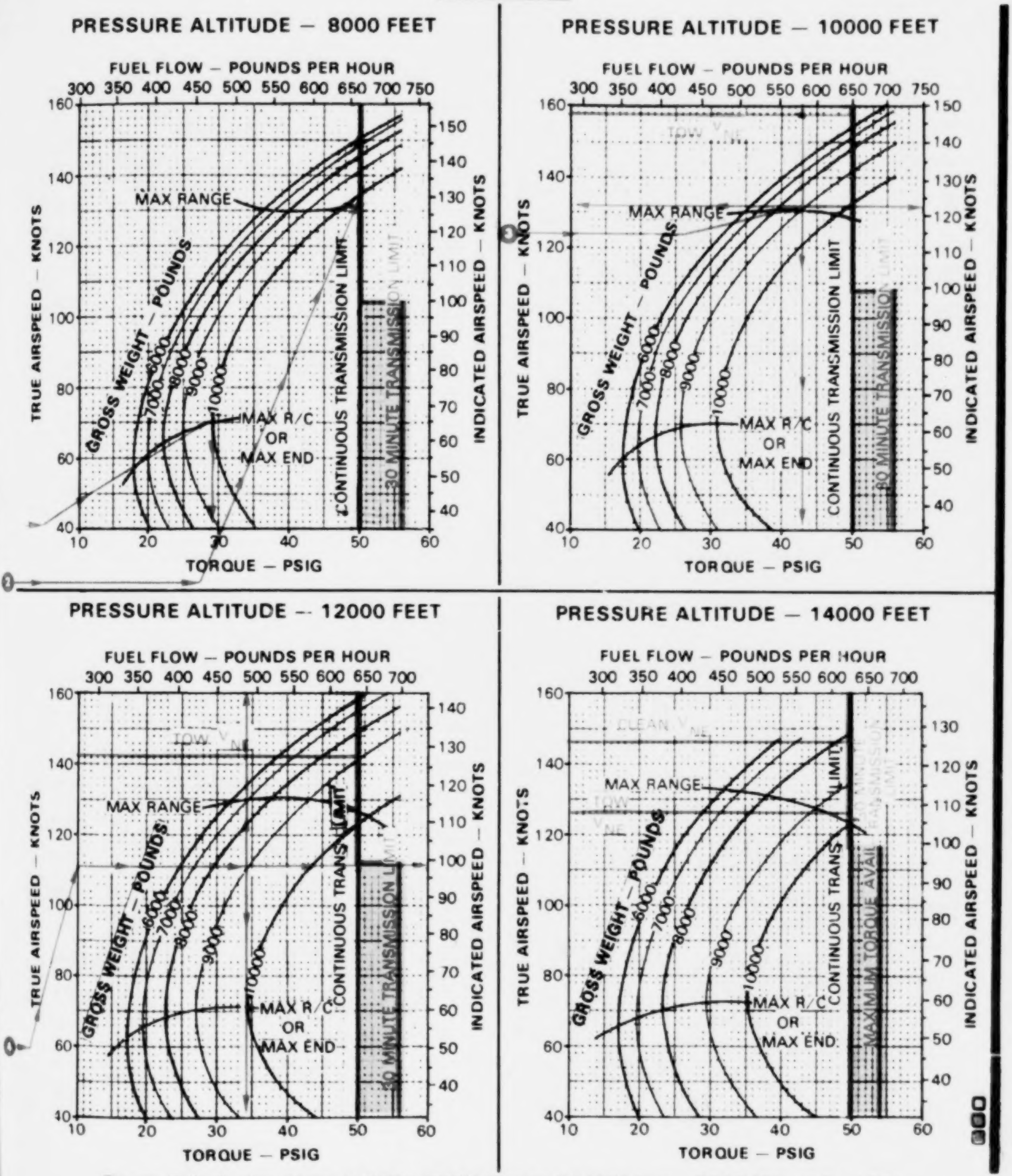


Figure 7-8 Cruise chart, 4 TOW, 8000 feet to 14,000 feet, -30°C (Sheet 2 of 24)

CRUISE

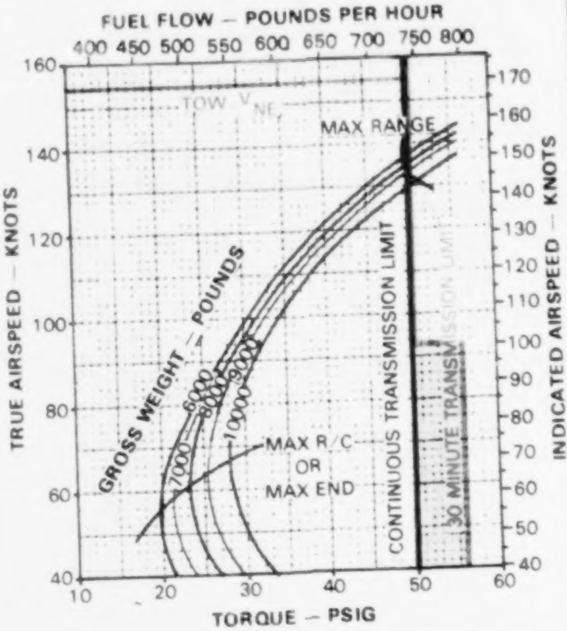
PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

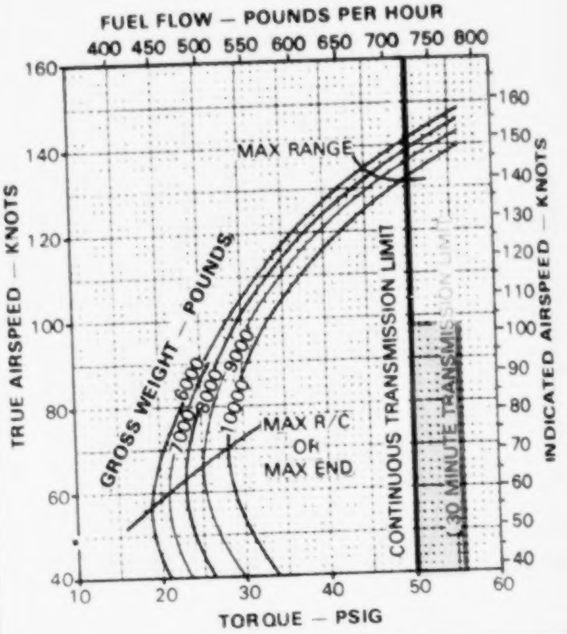
JP-4 FUEL OGE

FAT = -15°C

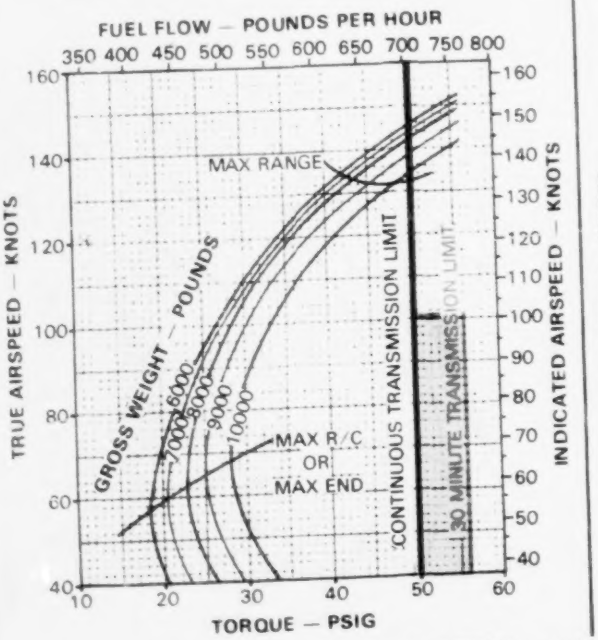
PRESSURE ALTITUDE — SEA LEVEL



PRESSURE ALTITUDE — 2000 FEET



PRESSURE ALTITUDE — 4000 FEET



PRESSURE ALTITUDE — 6000 FEET

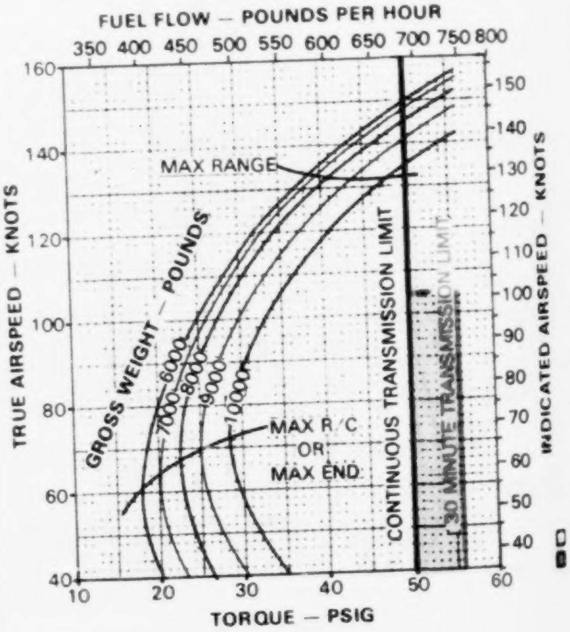


Figure 7-8 Cruise chart, 4 TOW, sea level to 6000 feet, -15°C (Sheet 3 of 24)

CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = -15°C

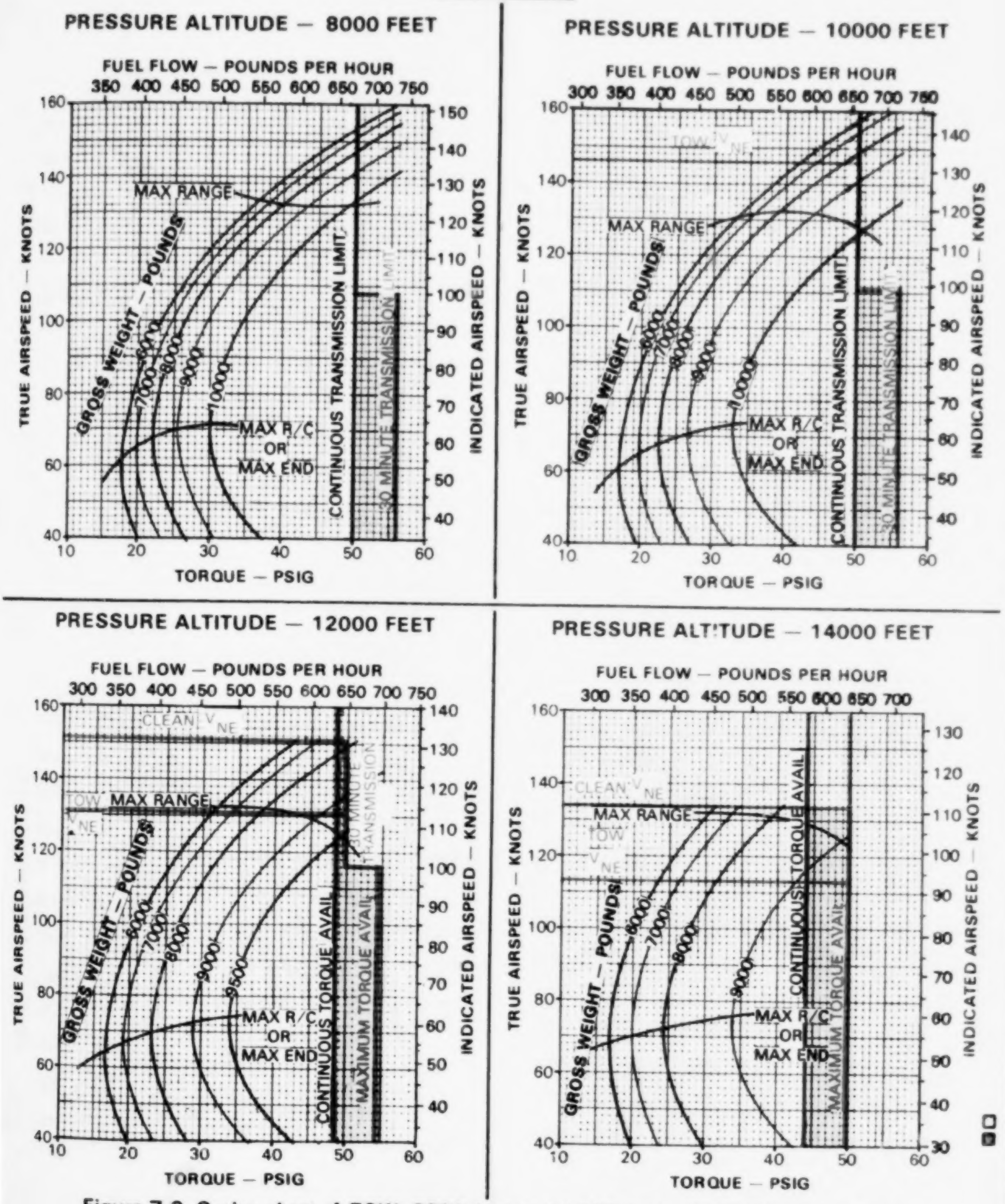


Figure 7-8 Cruise chart, 4 TOW, 8000 feet to 14,000 feet, -15°C (Sheet 4 of 24)

CRUISE
AH-1S
T53-L-703

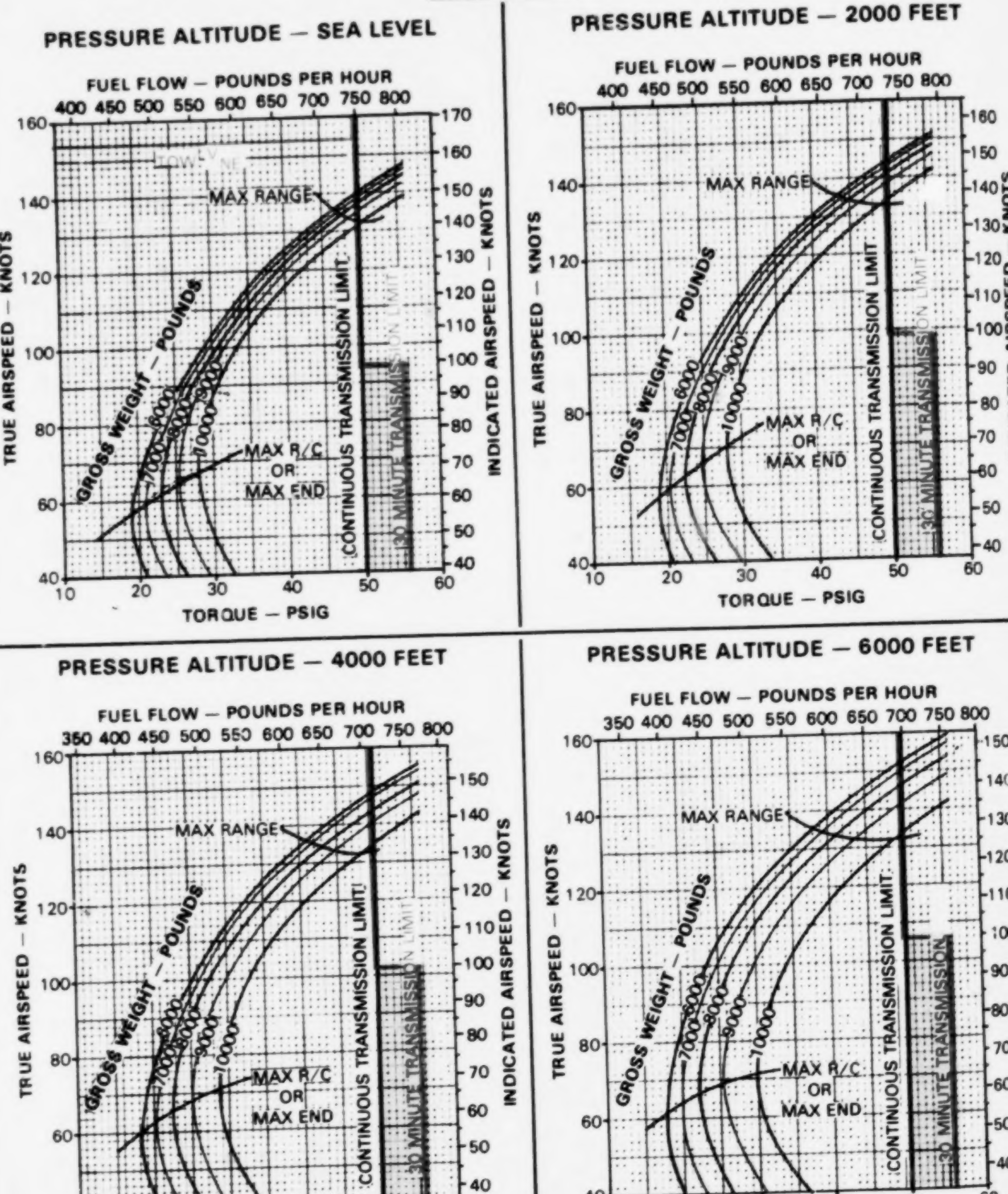
CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = 0°C


PRESSURE ALTITUDE — SEA LEVEL

PRESSURE ALTITUDE — 2000 FEET

PRESSURE ALTITUDE — 4000 FEET

PRESSURE ALTITUDE — 6000 FEET

Figure 7-8. Cruise chart, 4 TOW, sea level to 6000 feet, 0°C (Sheet 5 of 24)

CRUISE

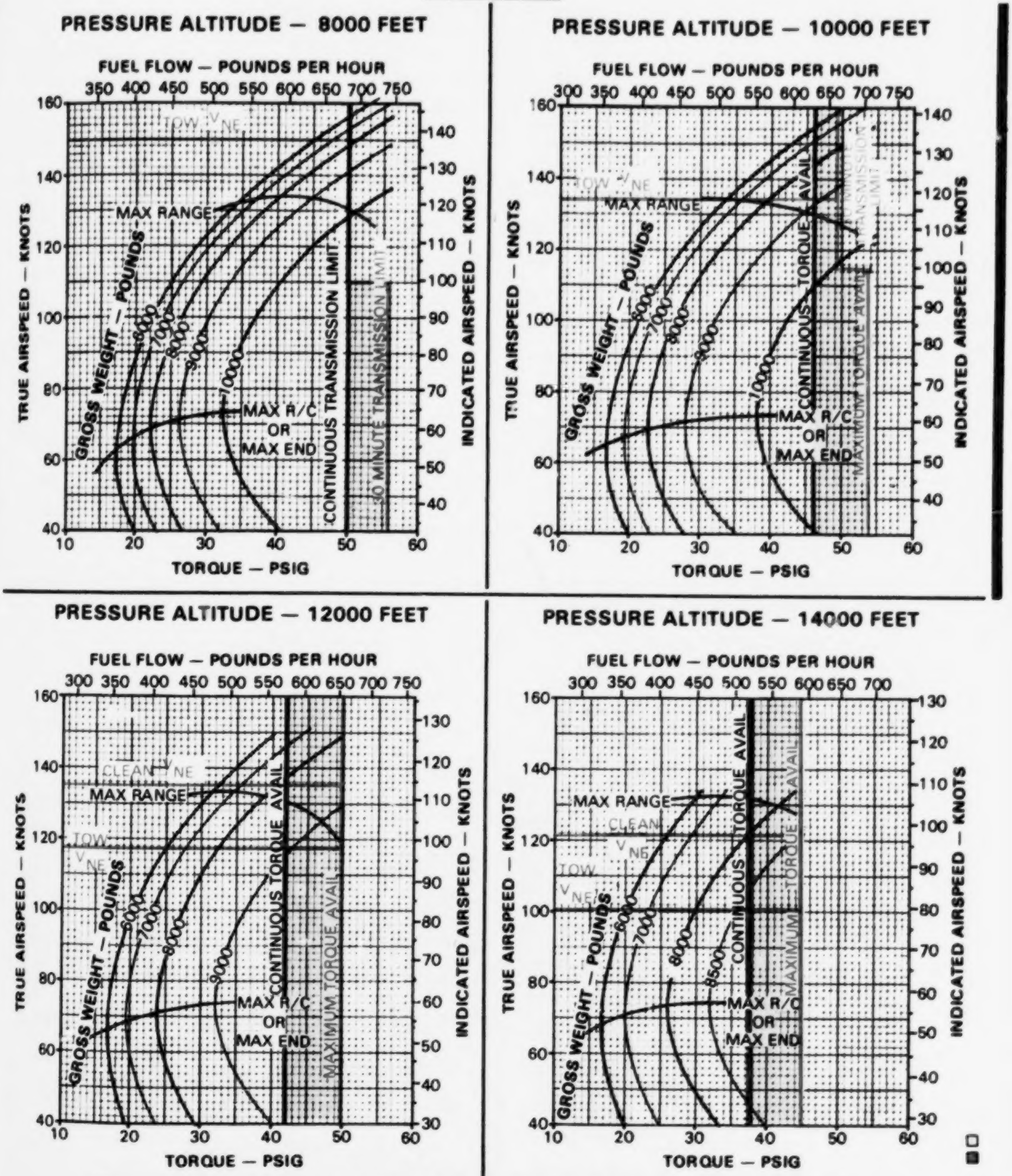
PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = 0°C

CRUISE
AH-1S
T53-L-703



PRESSURE ALTITUDE — 8000 FEET

PRESSURE ALTITUDE — 10000 FEET

PRESSURE ALTITUDE — 12000 FEET

PRESSURE ALTITUDE — 14000 FEET

Figure 7-8 Cruise chart, 4 TOW, 8000 feet to 14,000 feet, 0°C (Sheet 6 of 24)

CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = +15°C

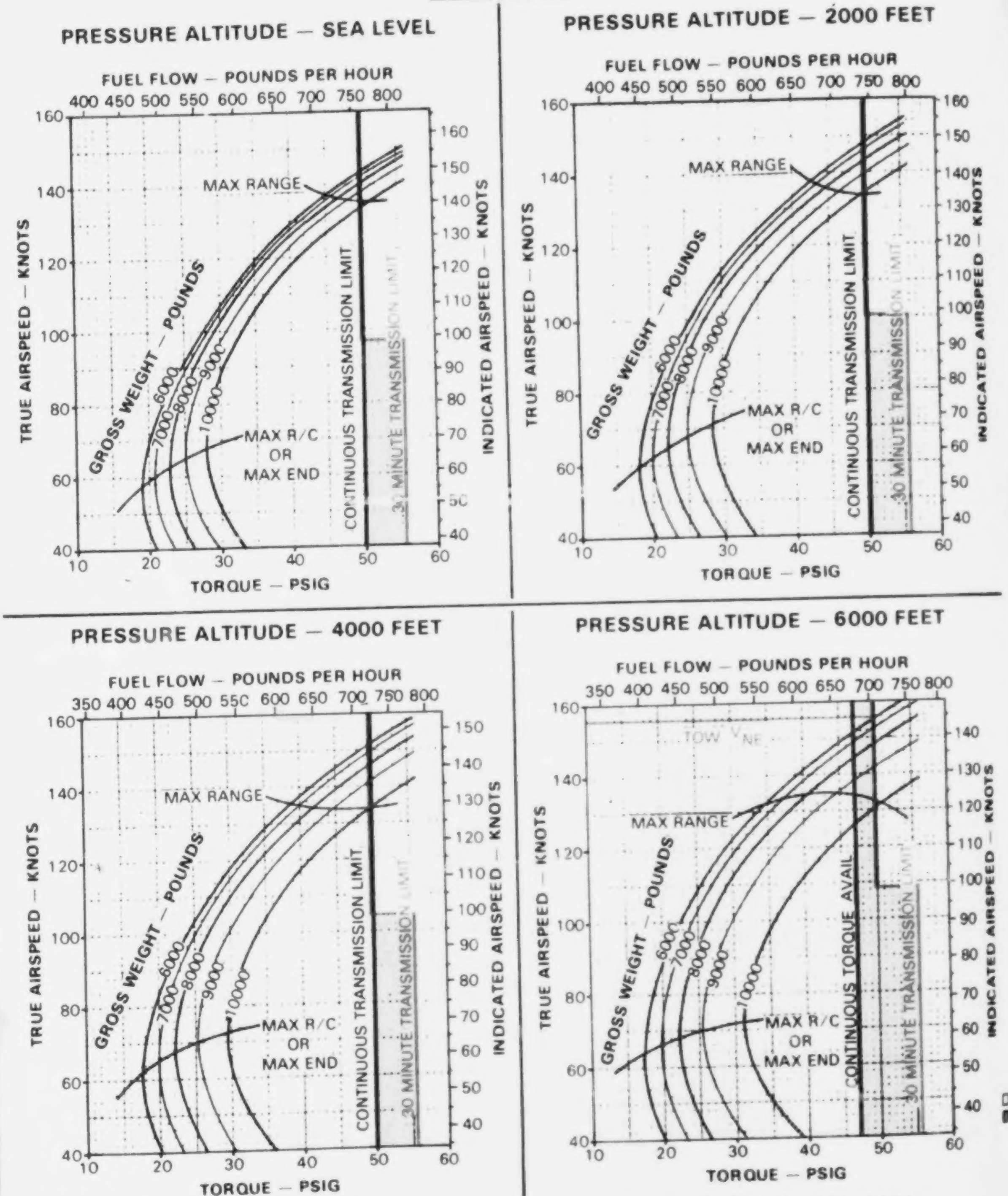


Figure 7-8 Cruise chart, 4 TOW, sea level to 6000 feet, +15°C (Sheet 7 of 24)

CRUISE
AH-1S
T53-L-703

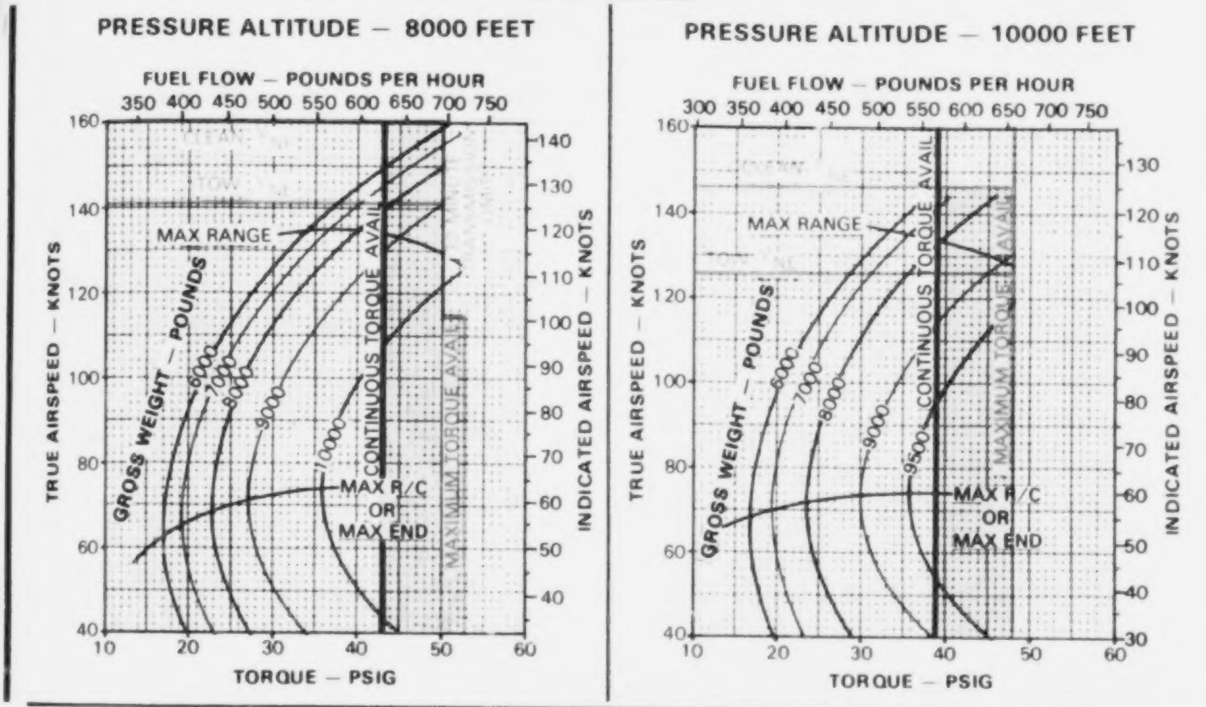
CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

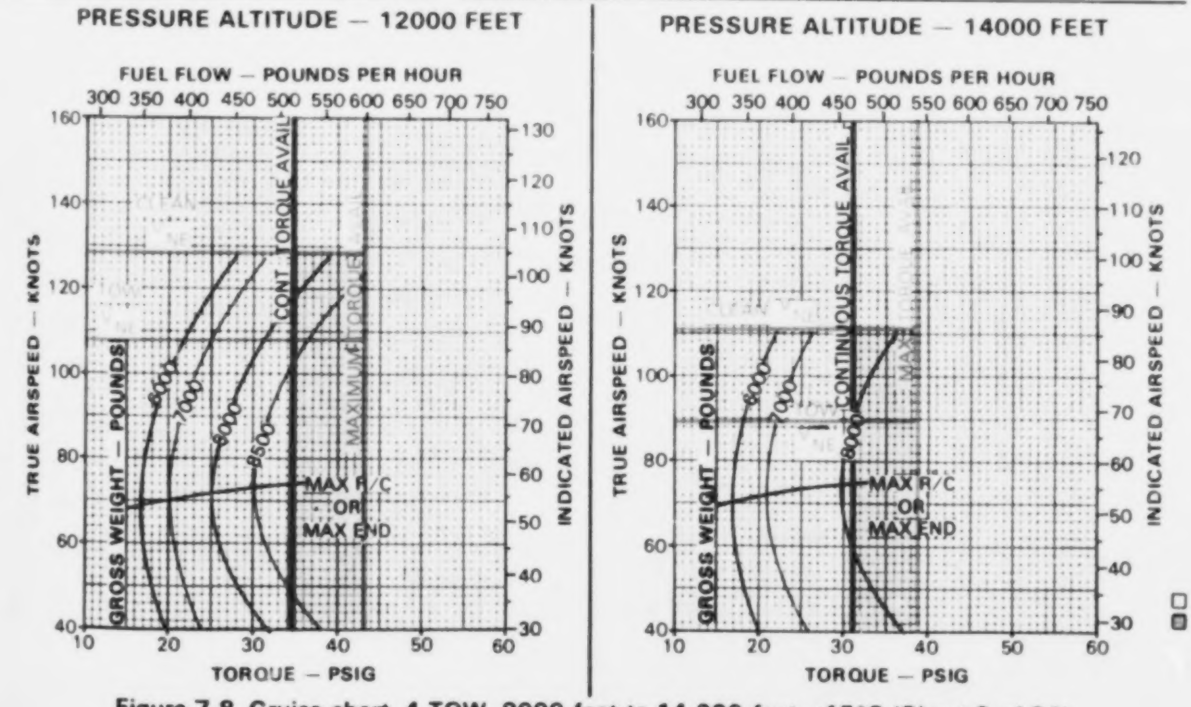
4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = +15°C


PRESSURE ALTITUDE — 8000 FEET

PRESSURE ALTITUDE — 10000 FEET


PRESSURE ALTITUDE — 12000 FEET

PRESSURE ALTITUDE — 14000 FEET

Figure 7-8 Cruise chart, 4 TOW, 8000 feet to 14,000 feet, +15°C (Sheet 8 of 24)

CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = +30°C

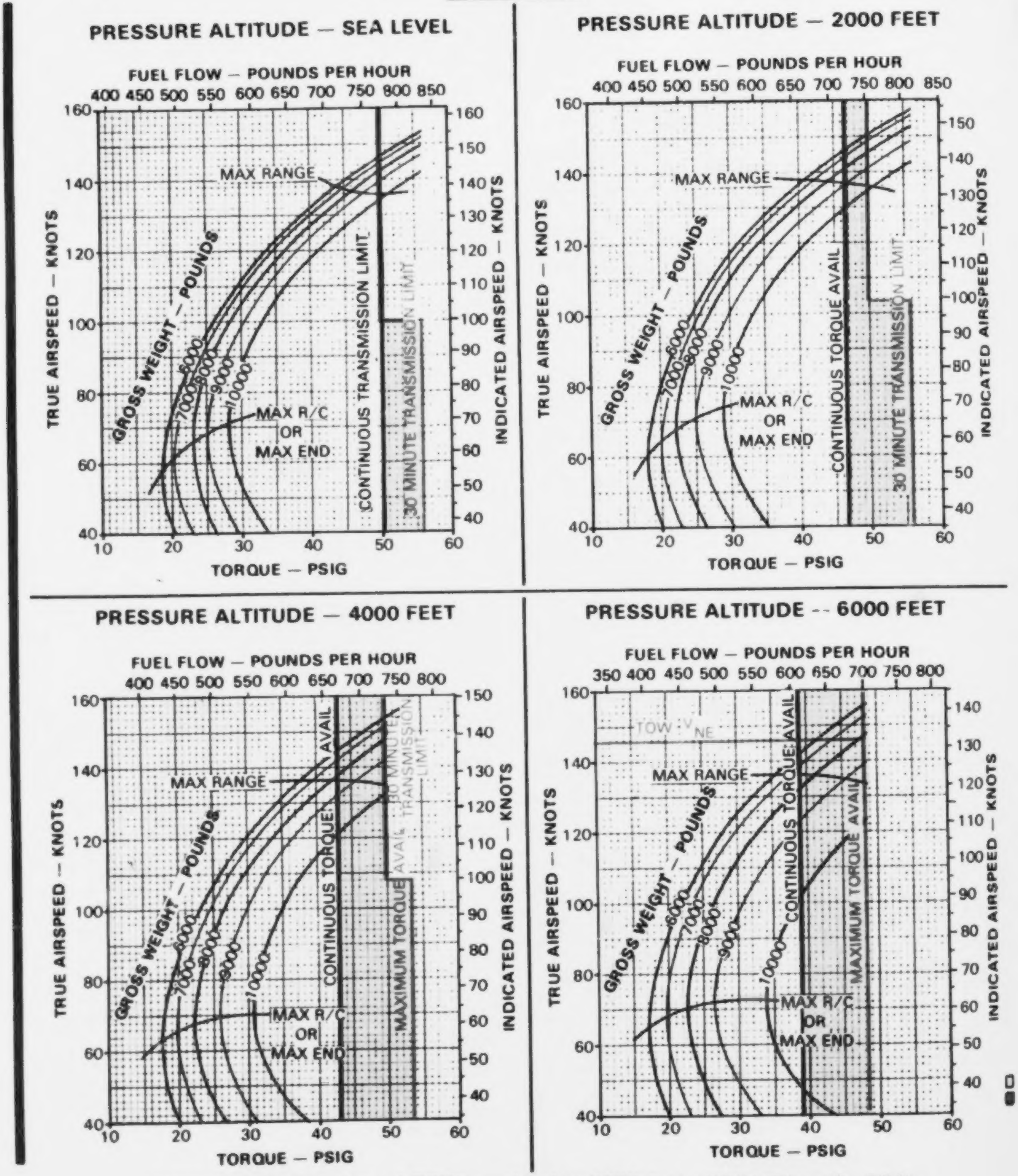


Figure 7-8 Cruise chart, 4 TOW, sea level to 6000 feet, +30°C (Sheet 9 of 24)

CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

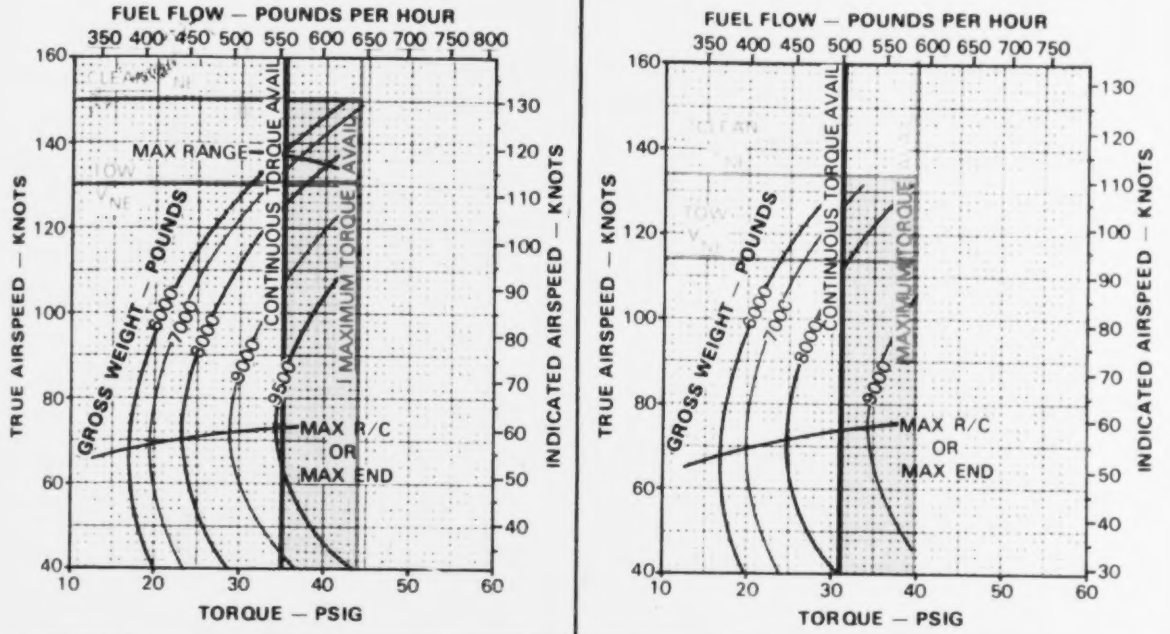
JP-4 FUEL OGE

FAT = +30°C

CRUISE
AH-1S
T53-L-703

PRESSURE ALTITUDE — 8000 FEET

PRESSURE ALTITUDE — 10000 FEET



PRESSURE ALTITUDE — 12000 FEET

PRESSURE ALTITUDE — 14000 FEET

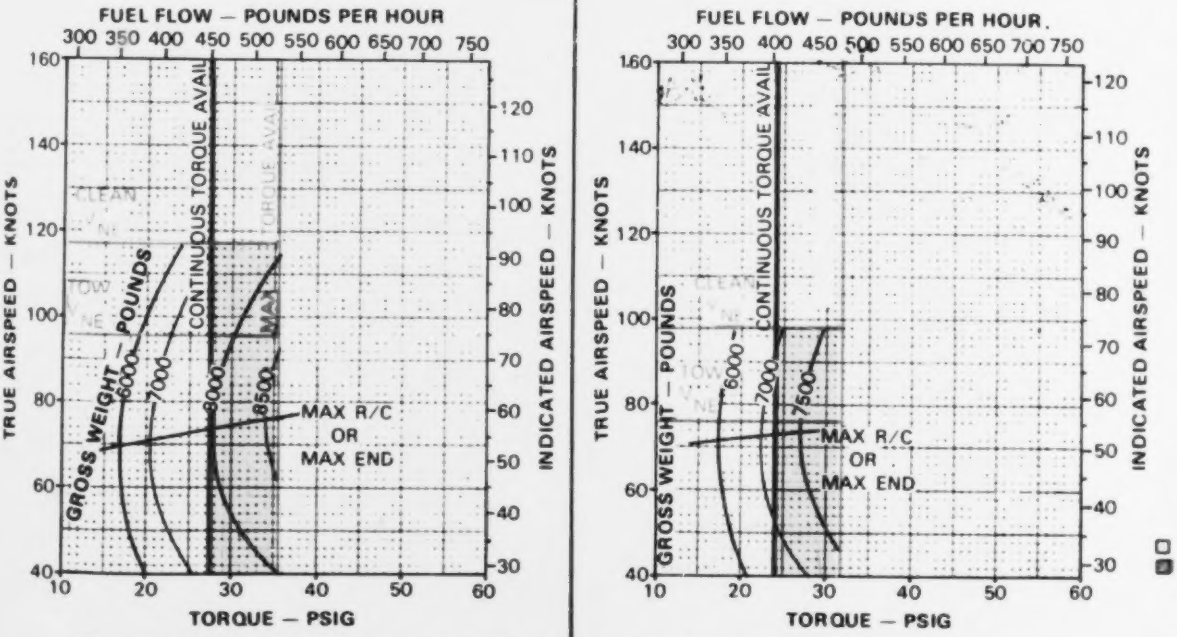


Figure 7-8 Cruise chart, 4 TOW, 8000 feet to 14,000 feet, +30°C (Sheet 10 of 24)

CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = +45°C

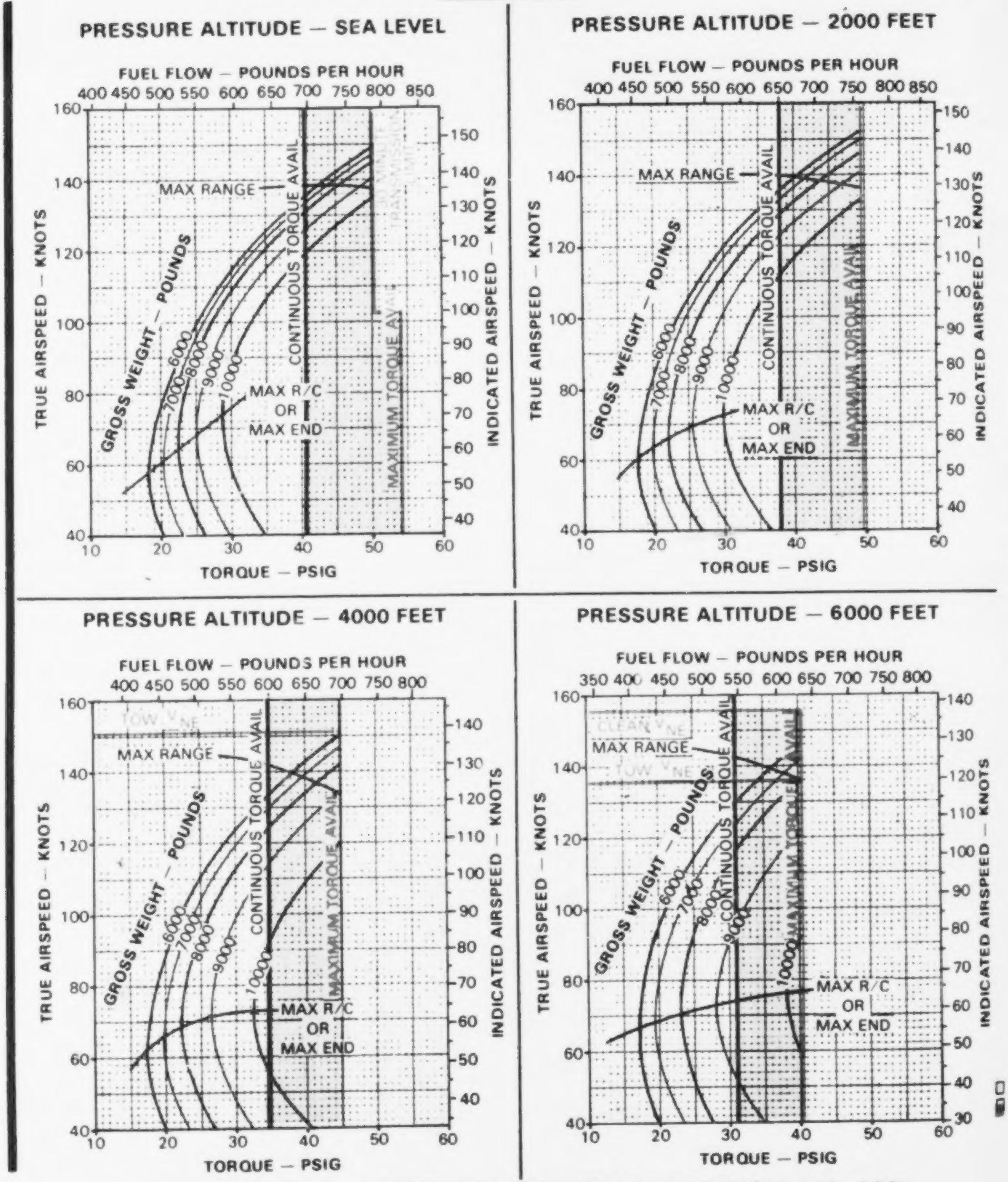


Figure 7-8 Cruise chart, 4 TOW, sea level to 6000 feet, +45°C (Sheet 11 of 24)

CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

4 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

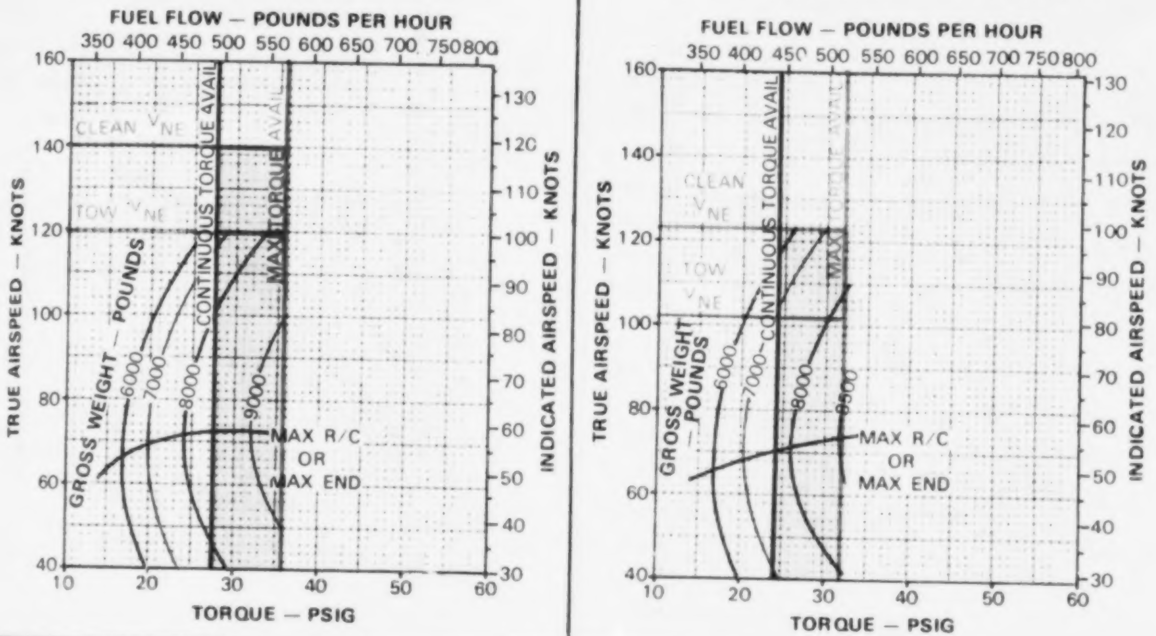
JP-4 FUEL OGE

FAT = +45°C

CRUISE
AH-1S
T53-L-703

PRESSURE ALTITUDE — 8000 FEET

PRESSURE ALTITUDE — 10000 FEET



PRESSURE ALTITUDE — 12000 FEET

PRESSURE ALTITUDE — 14000 FEET

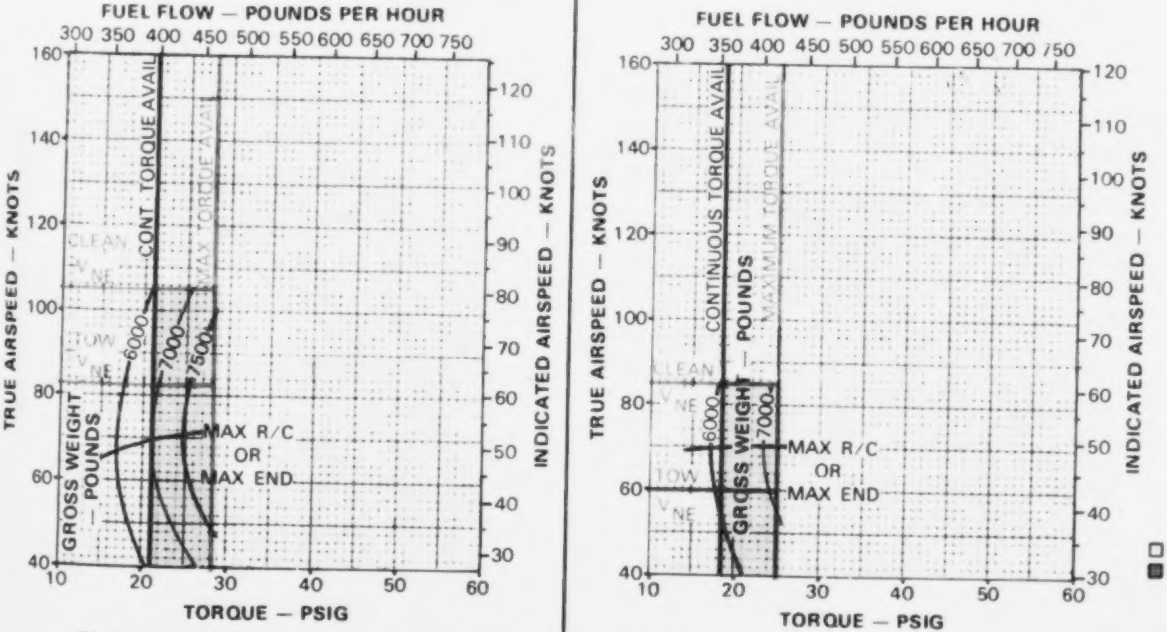


Figure 7-8 Cruise chart, 4 TOW, 8000 feet to 14,000 feet, +45°C (Sheet 12 of 24)

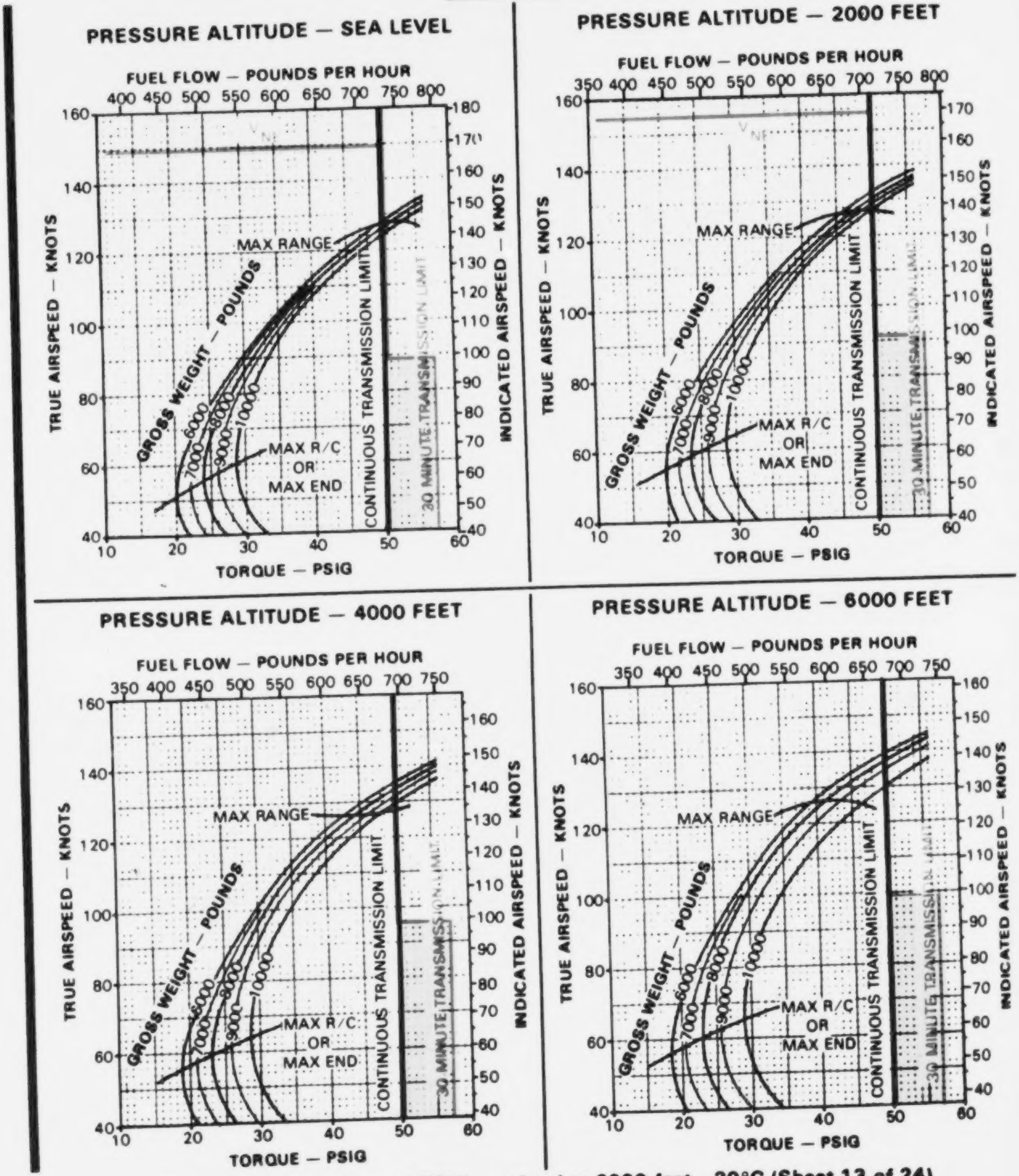
CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = -30°C



PRESSURE ALTITUDE — SEA LEVEL

PRESSURE ALTITUDE — 2000 FEET

PRESSURE ALTITUDE — 4000 FEET

PRESSURE ALTITUDE — 6000 FEET

Figure 7-8 Cruise chart, 8 TOW, sea level to 6000 feet, -30°C (Sheet 13 of 24)

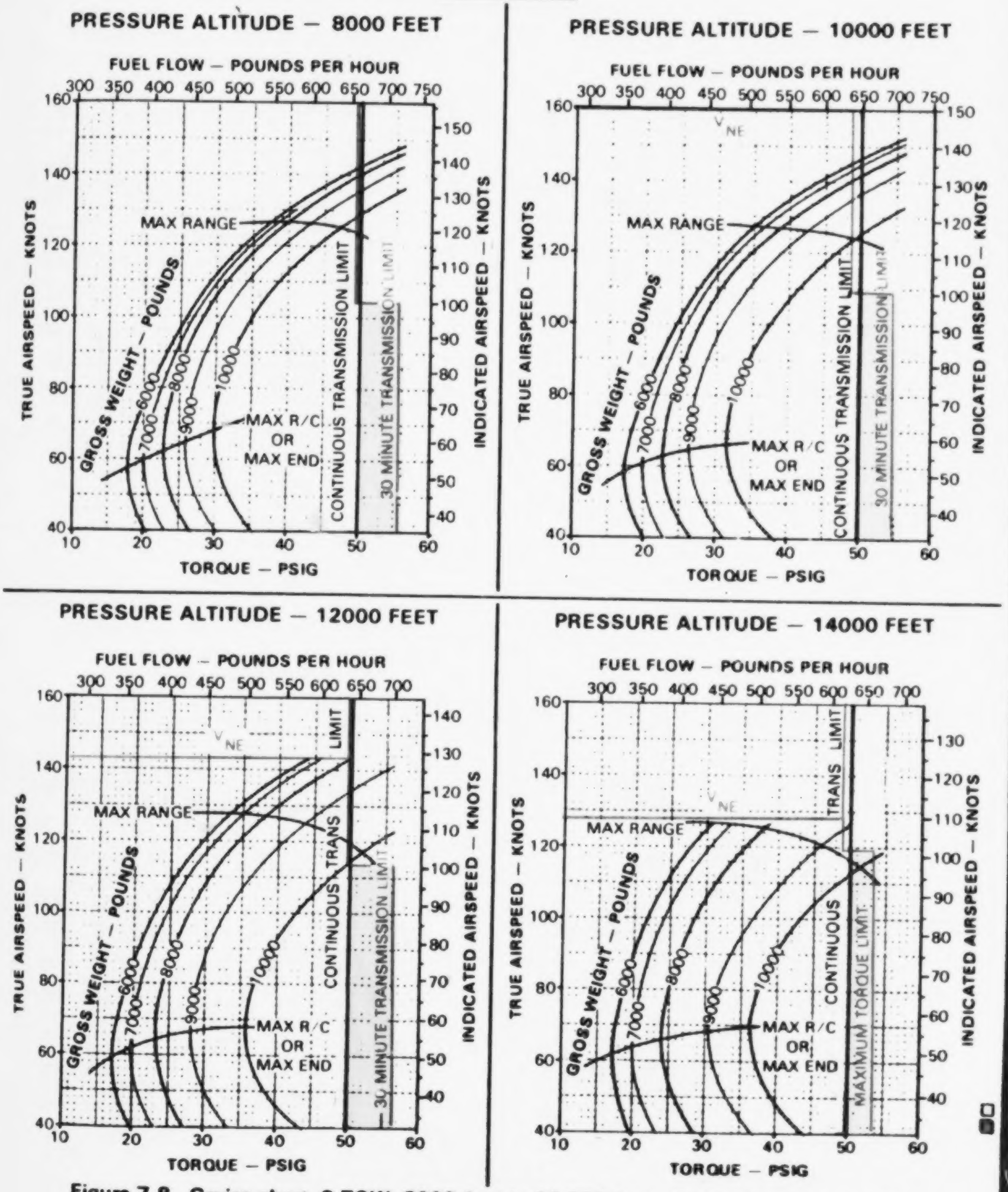
CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = -30°C


PRESSURE ALTITUDE — 8000 FEET

PRESSURE ALTITUDE — 10000 FEET

PRESSURE ALTITUDE — 12000 FEET

PRESSURE ALTITUDE — 14000 FEET

Figure 7-8. Cruise chart, 8 TOW, 8000 feet to 14,000 feet, -30°C (Sheet 14 of 24)

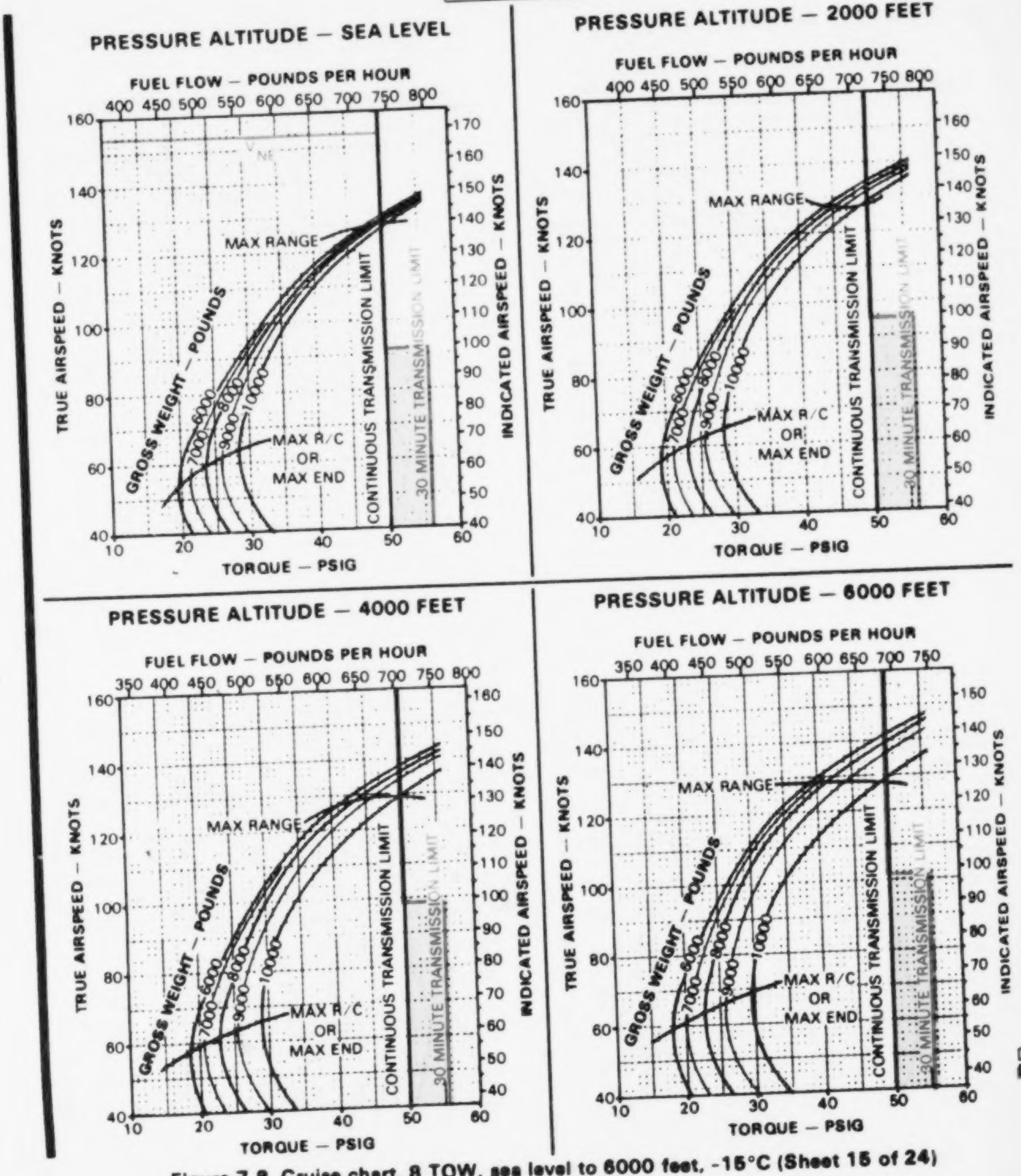
CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = -15°C



PRESSURE ALTITUDE — SEA LEVEL

PRESSURE ALTITUDE — 2000 FEET

PRESSURE ALTITUDE — 4000 FEET

PRESSURE ALTITUDE — 6000 FEET

Figure 7-8 Cruise chart, 8 TOW, sea level to 6000 feet, -15°C (Sheet 15 of 24)

CRUISE

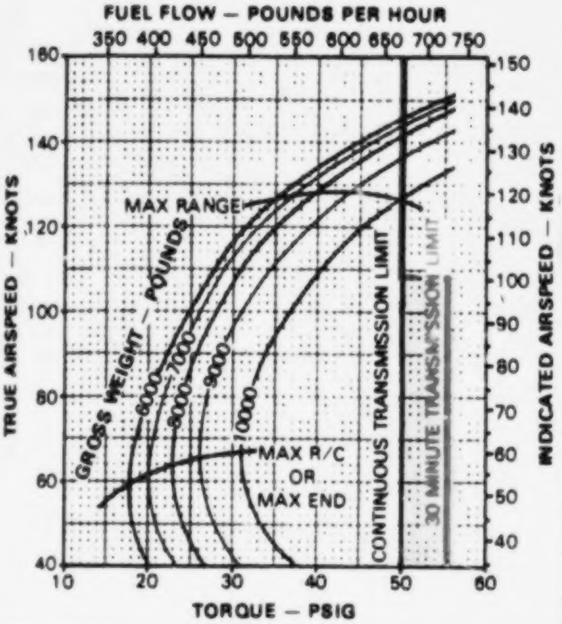
PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

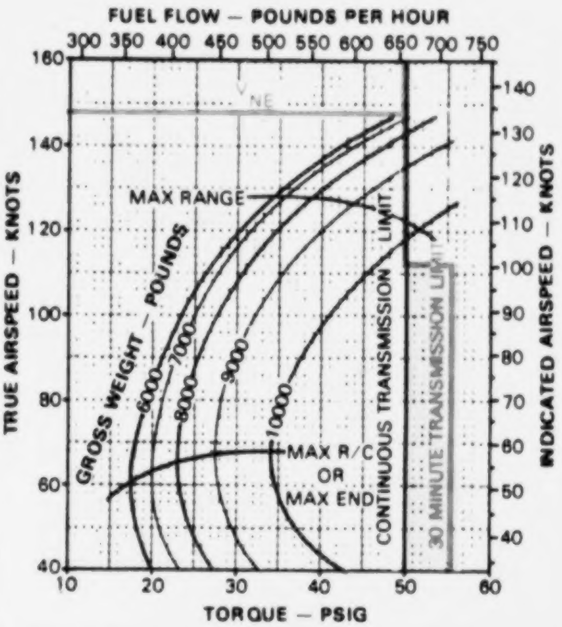
JP-4 FUEL OGE

FAT = -15°C

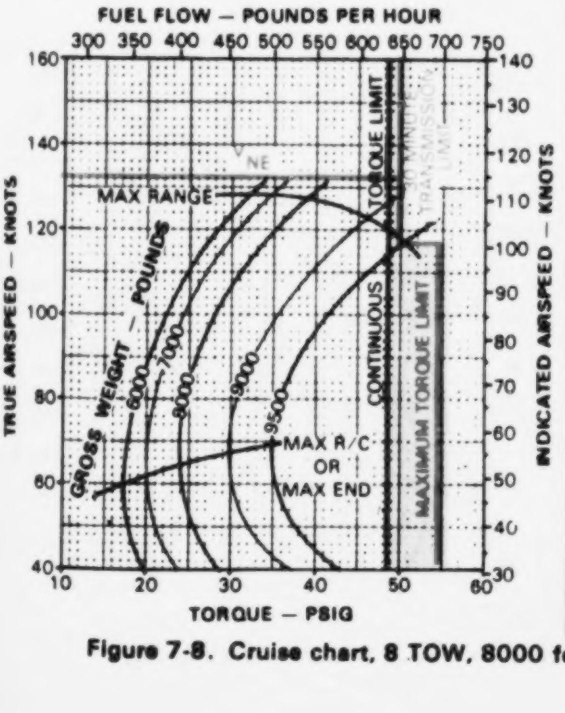
PRESSURE ALTITUDE — 8000 FEET



PRESSURE ALTITUDE — 10000 FEET



PRESSURE ALTITUDE — 12000 FEET



PRESSURE ALTITUDE — 14000 FEET

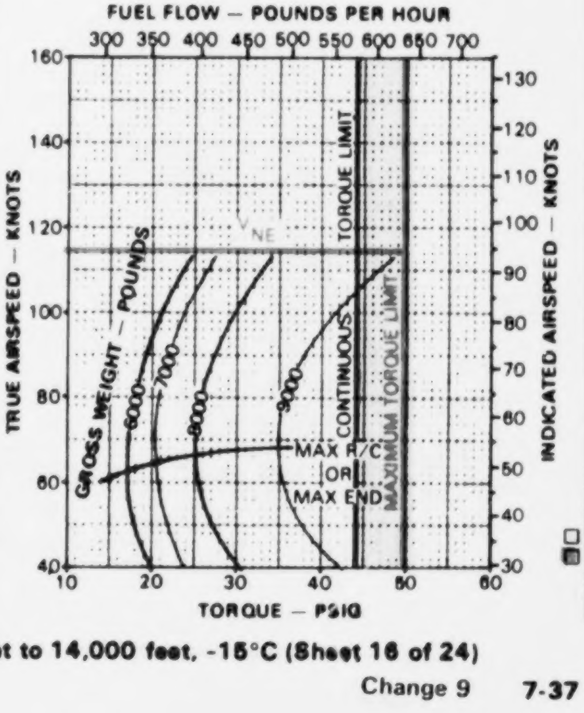


Figure 7-8. Cruise chart, 8 TOW, 8000 feet to 14,000 feet, -15°C (Sheet 16 of 24)

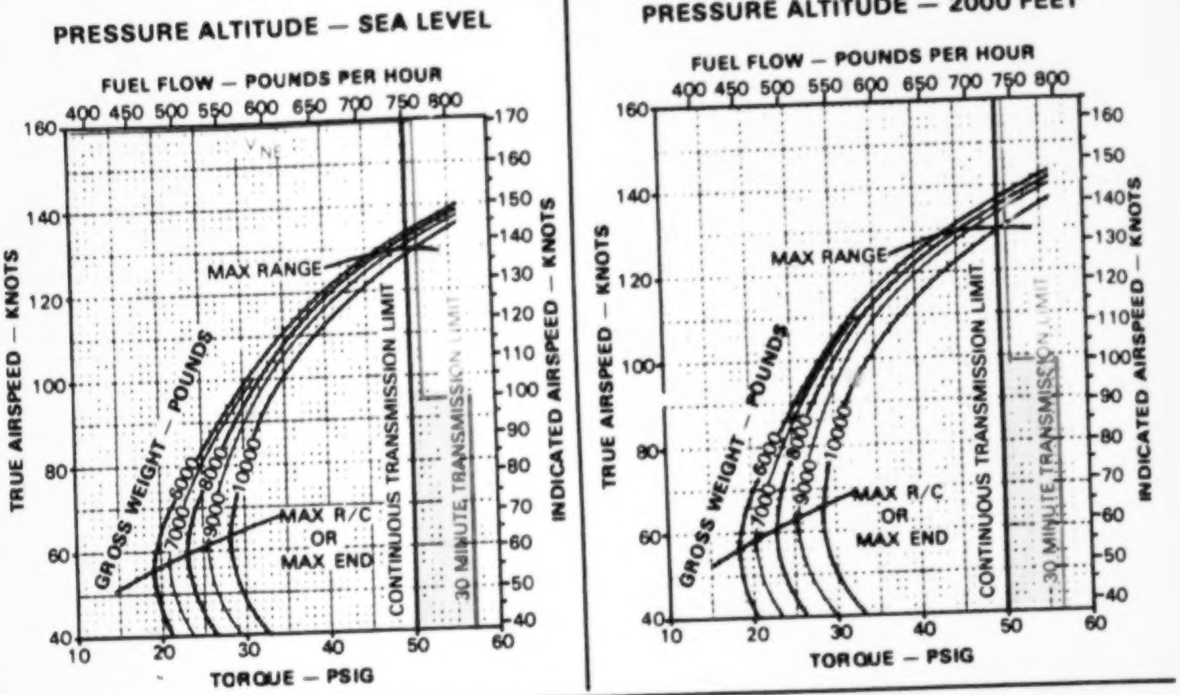
CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

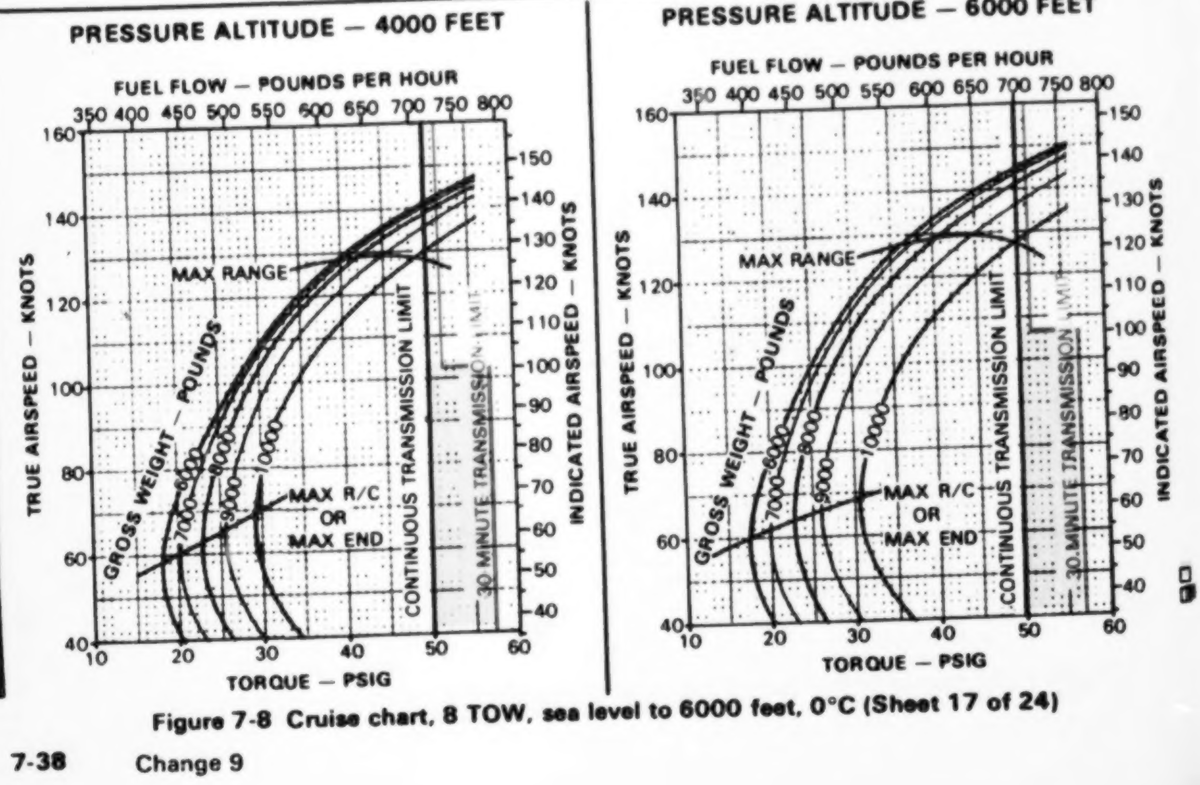
8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = 0°C


PRESSURE ALTITUDE — SEA LEVEL

PRESSURE ALTITUDE — 2000 FEET


PRESSURE ALTITUDE — 4000 FEET

PRESSURE ALTITUDE — 6000 FEET

Figure 7-8 Cruise chart, 8 TOW, sea level to 6000 feet, 0°C (Sheet 17 of 24)

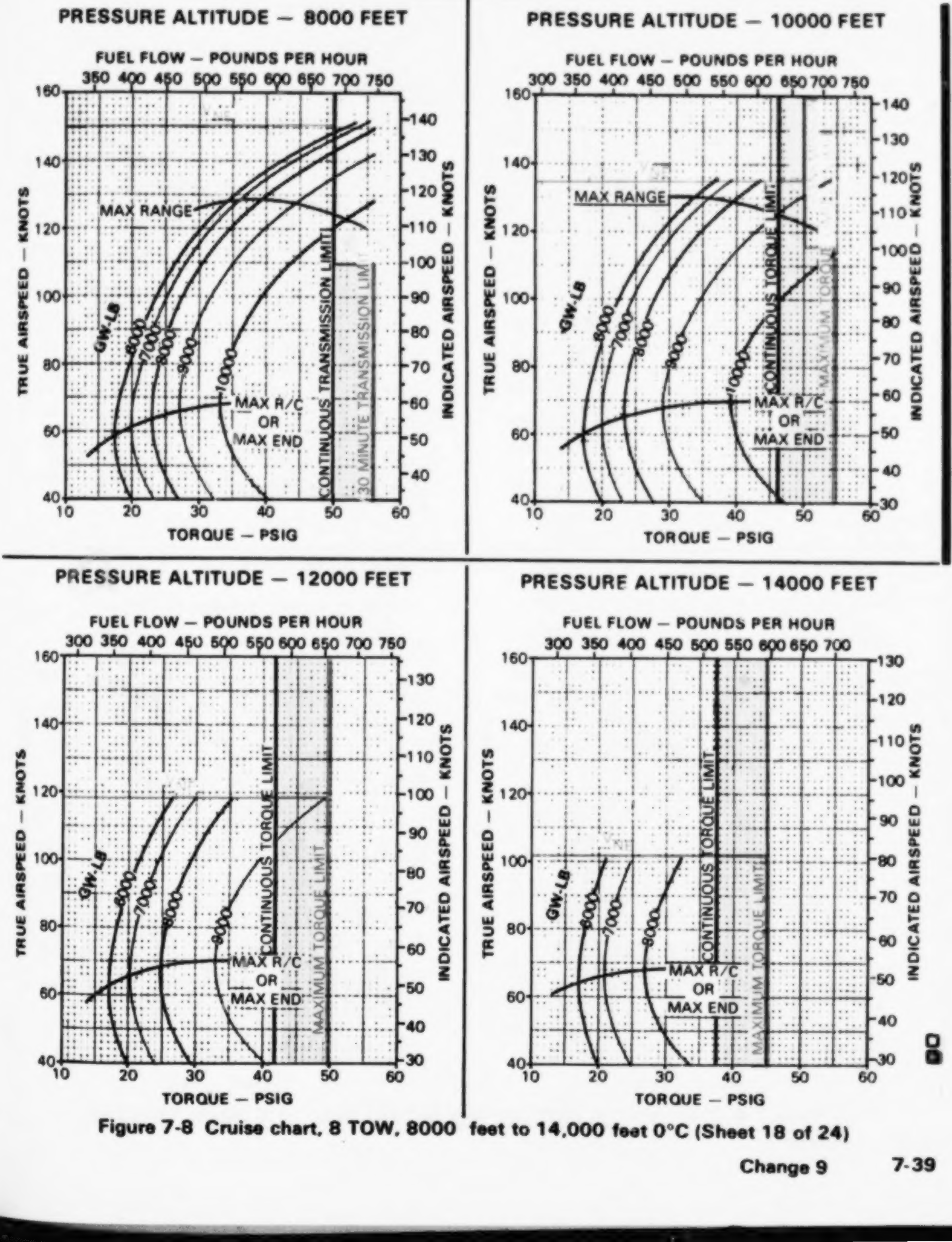
CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = 0°C


PRESSURE ALTITUDE — 8000 FEET

PRESSURE ALTITUDE — 10000 FEET

PRESSURE ALTITUDE — 12000 FEET

PRESSURE ALTITUDE — 14000 FEET

Figure 7-8 Cruise chart, 8 TOW, 8000 feet to 14,000 feet 0°C (Sheet 18 of 24)

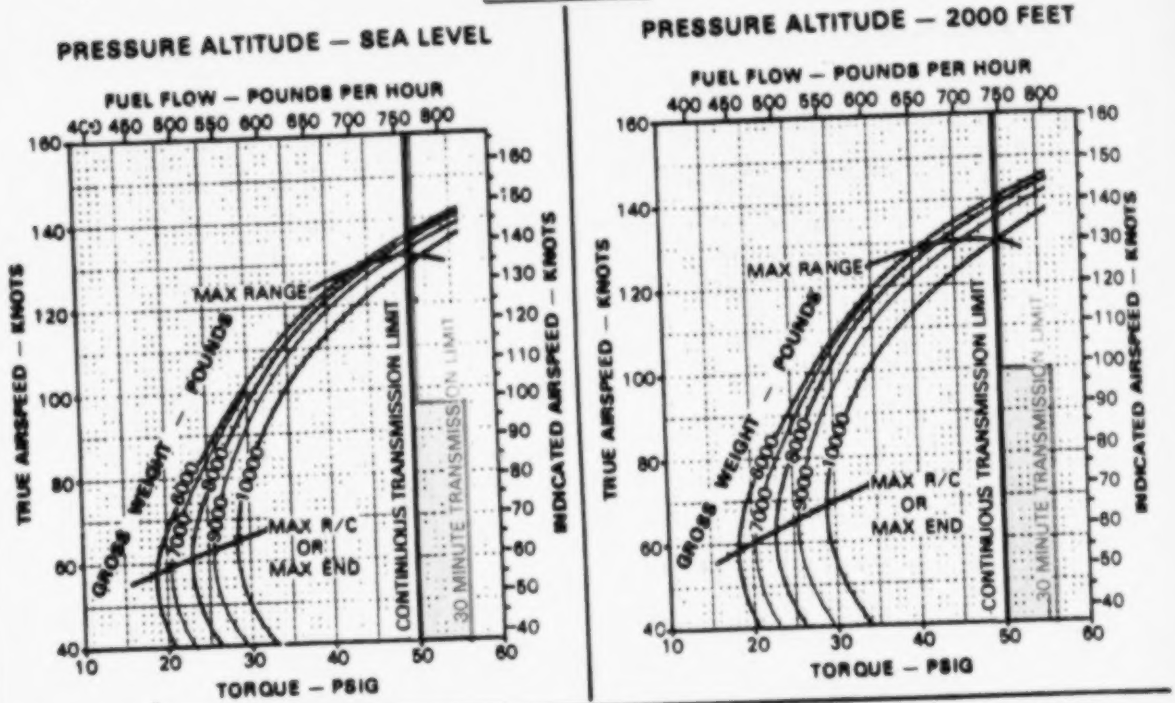
CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

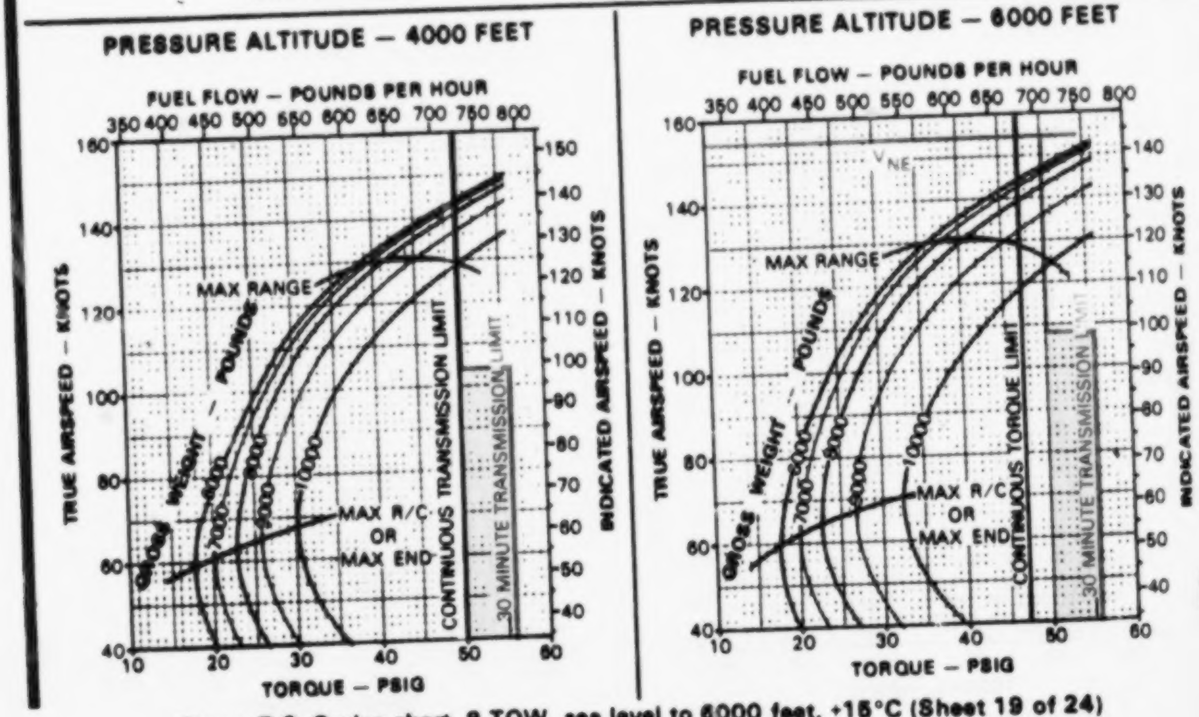
8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = +15°C


PRESSURE ALTITUDE — SEA LEVEL

PRESSURE ALTITUDE — 2000 FEET


PRESSURE ALTITUDE — 4000 FEET

PRESSURE ALTITUDE — 6000 FEET

Figure 7-8 Cruise chart, 8 TOW, sea level to 6000 feet, +15°C (Sheet 19 of 24)

CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

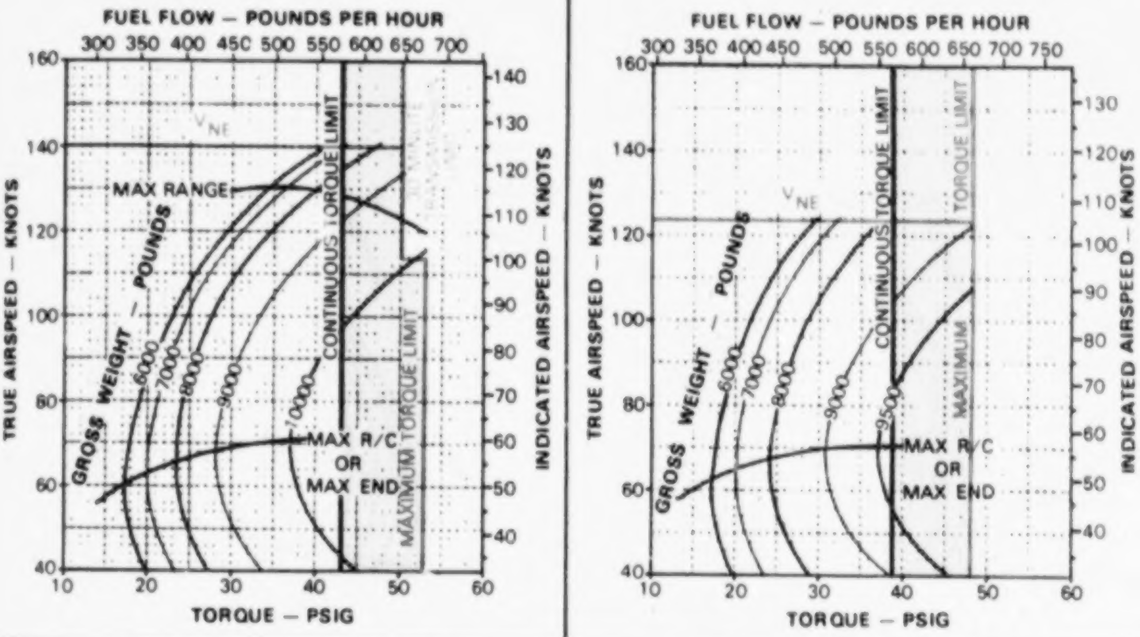
8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = +15°C

CRUISE
AH-1S
T53-L-703

PRESSURE ALTITUDE — 8000 FEET **PRESSURE ALTITUDE — 10000 FEET**



PRESSURE ALTITUDE — 12000 FEET **PRESSURE ALTITUDE — 14000 FEET**

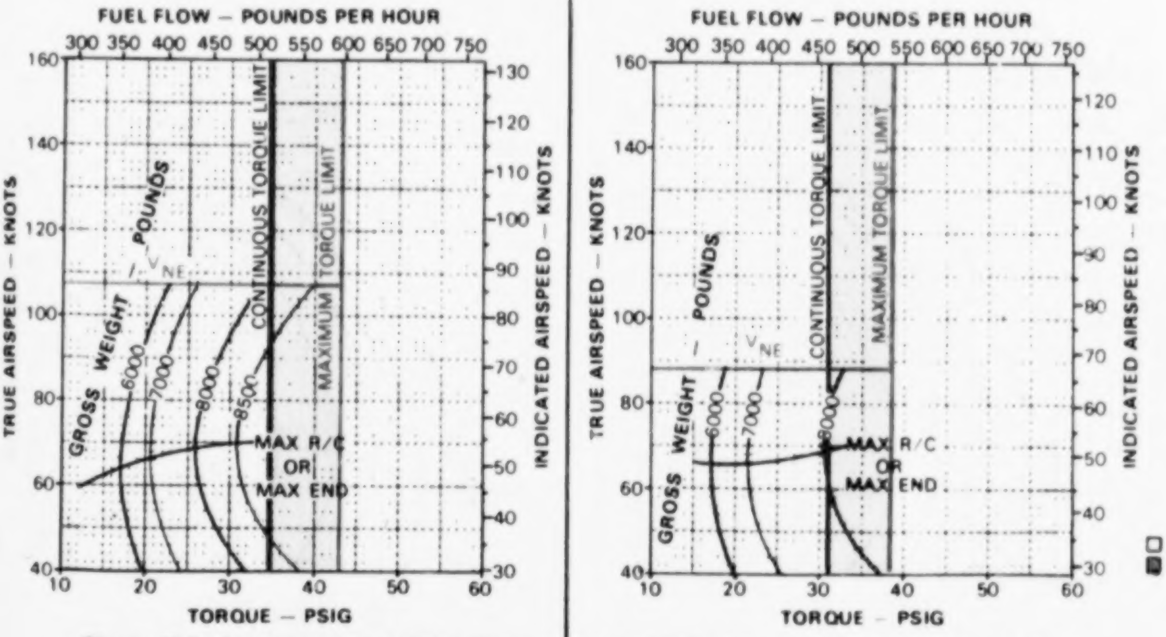


Figure 7-8 Cruise chart, 8 TOW, 8000 feet to 14,000 feet, +15°C (Sheet 20 of 24)

CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT =+30°C

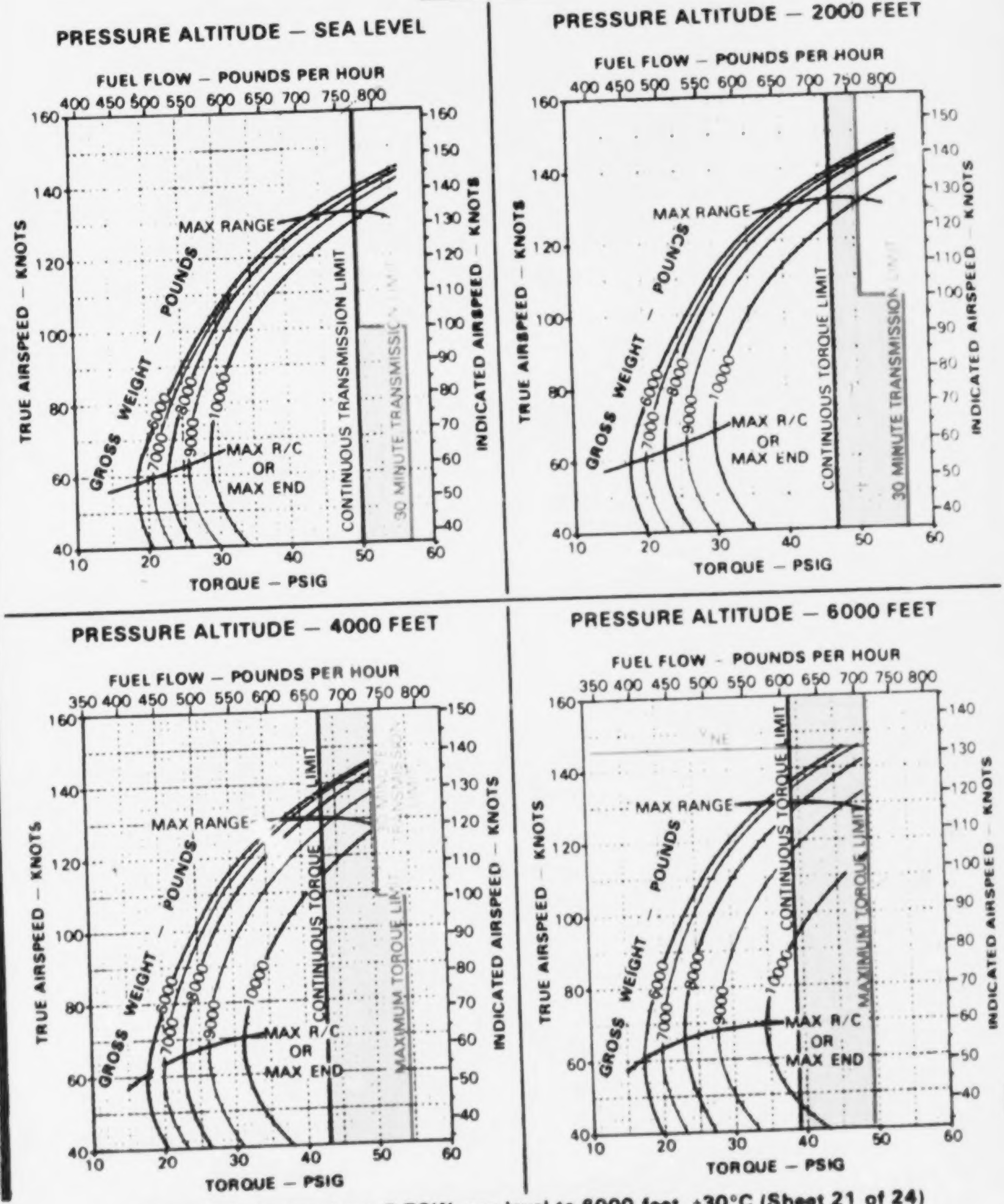


Figure 7-8 Cruise chart, 8 TOW, sea level to 6000 feet, +30°C (Sheet 21 of 24)

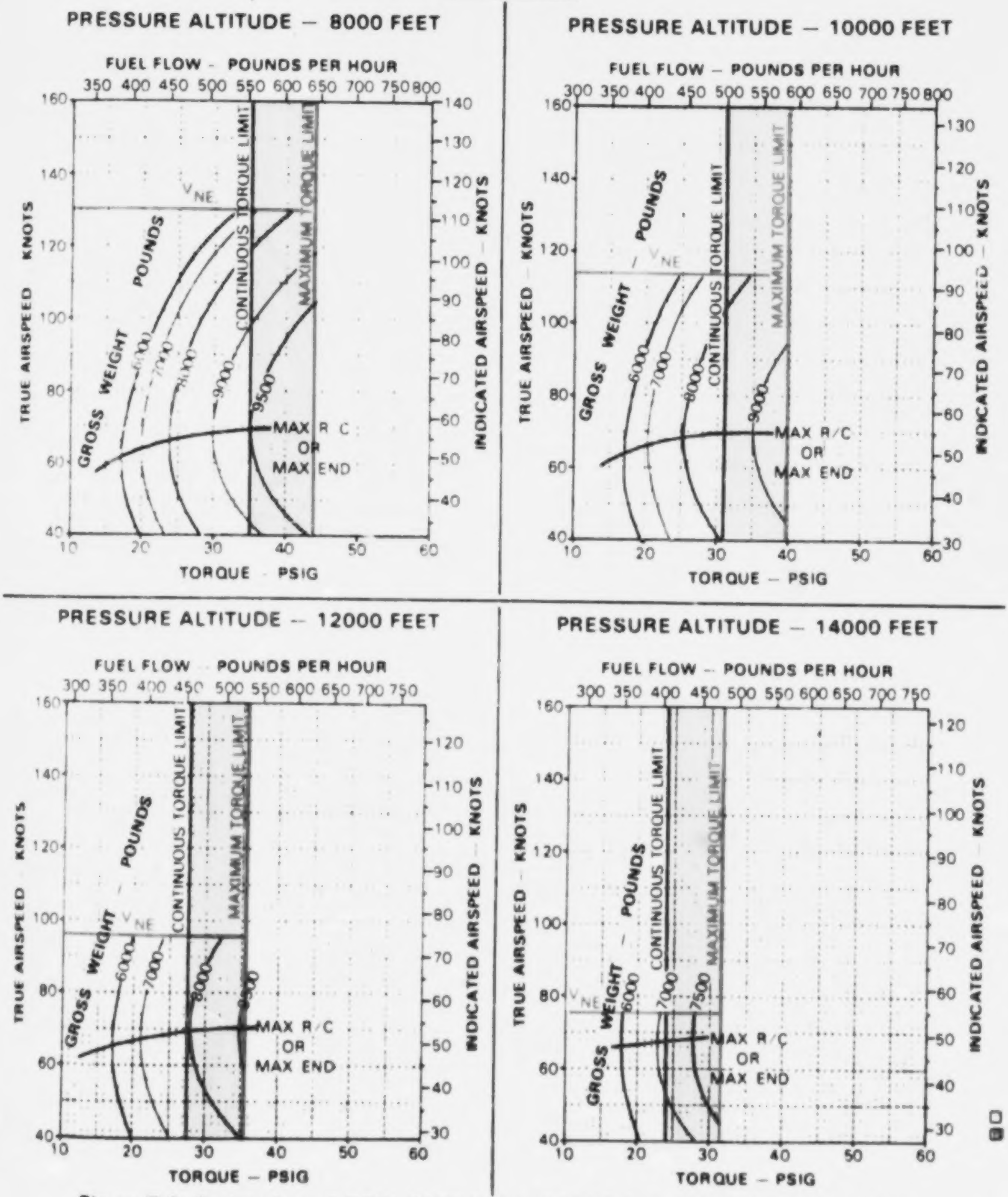
CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = +30°C


PRESSURE ALTITUDE — 8000 FEET

PRESSURE ALTITUDE — 10000 FEET

PRESSURE ALTITUDE — 12000 FEET

PRESSURE ALTITUDE — 14000 FEET

Figure 7-8 Cruise chart, 8 TOW, 8000 feet to 14,000 feet, +30°C (Sheet 22 of 24)

CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET

8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = +45°C

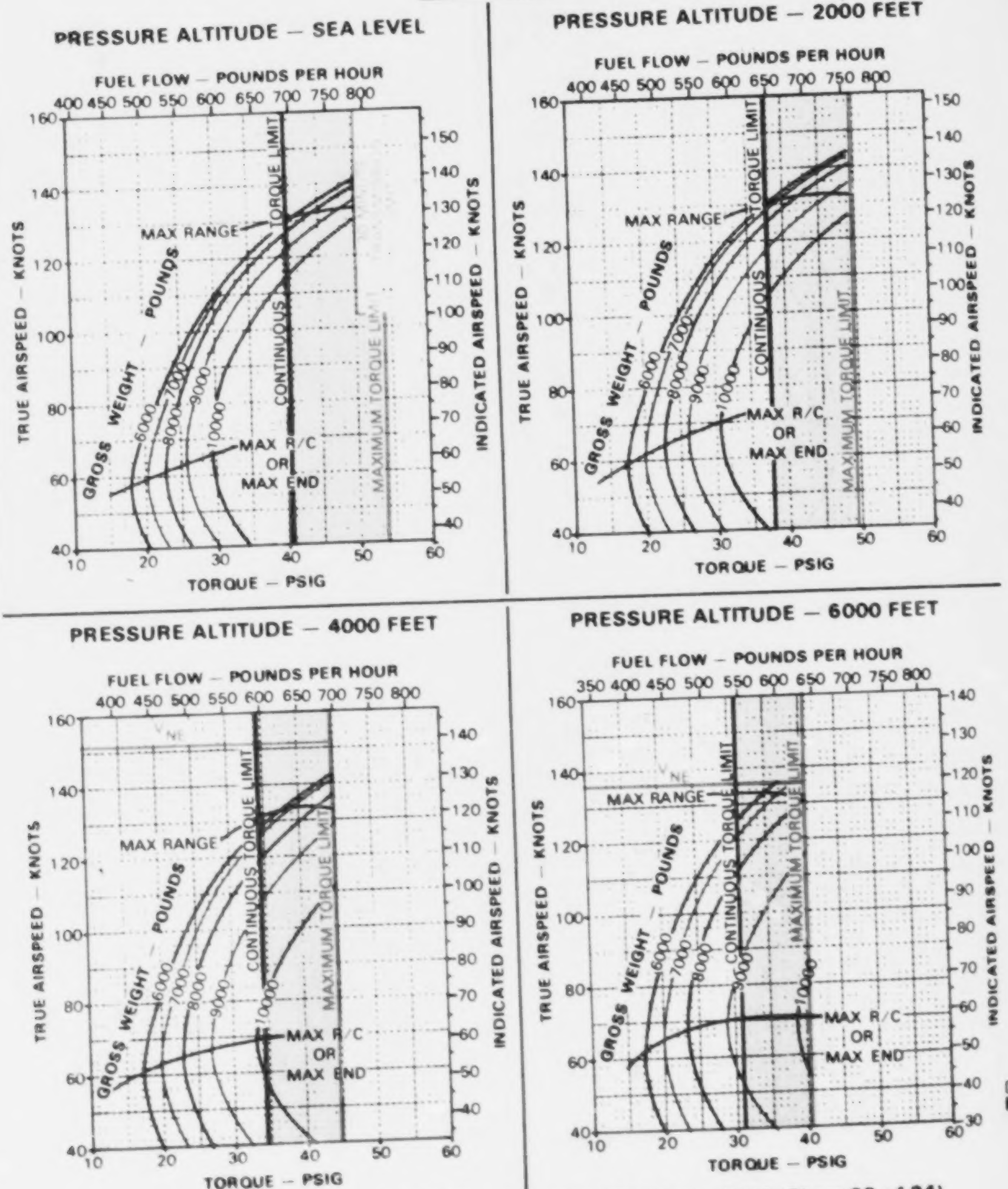


Figure 7-8 Cruise chart, 8 TOW, sea level to 6000 feet, +45°C (Sheet 23 of 24)

CRUISE

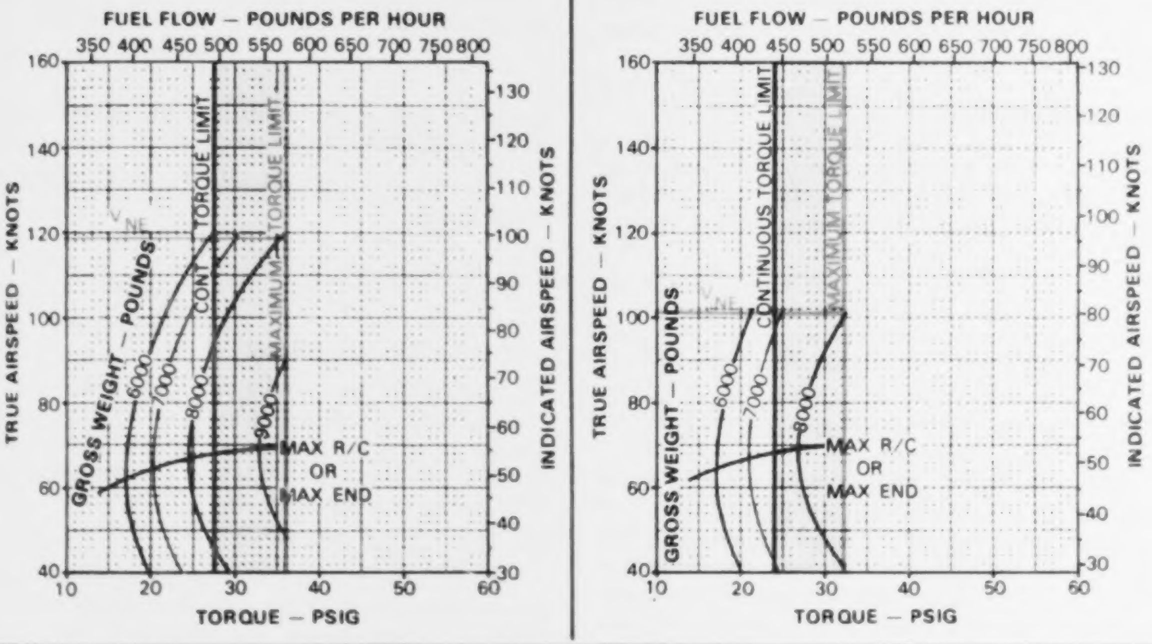
PRESSURE ALTITUDE — 8000 FEET TO 12000 FEET

8 TOW MISSILE CONFIGURATION 324 ROTOR/6600 ENGINE RPM

JP-4 FUEL OGE

FAT = +45°C

CRUISE
AH-1S
T53-L-703


PRESSURE ALTITUDE — 8000 FEET

PRESSURE ALTITUDE — 10000 FEET

PRESSURE ALTITUDE — 12000 FEET

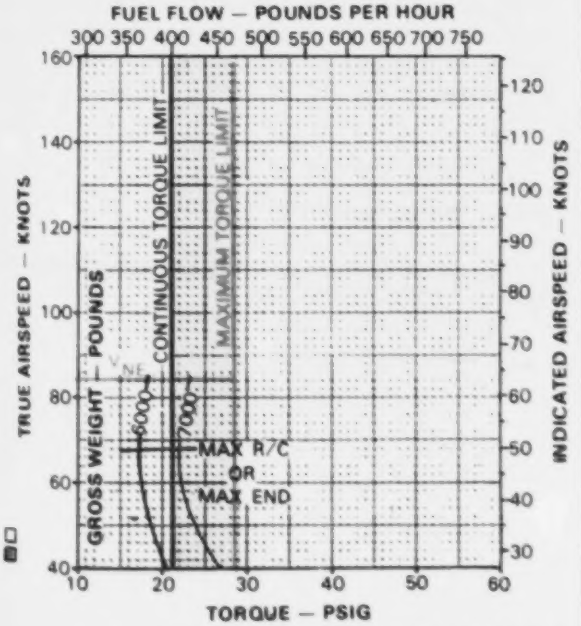


Figure 7-8 Cruise chart, 8 TOW, 8000 feet to 12,000 feet, +45°C (Sheet 24 of 24)

Section VIII. DRAG

7-30. Description.

The drag chart (figure 7-9, sheet 2 of 2) shows the additional torque change required for flight due to drag area change as a result of external configuration changes. Note that figure 7-9, sheet 1 of 2, presents the drag increments of many approved armament configurations.

7-31. Use of Chart.

The primary use of the chart is illustrated by the example. To determine the change in torque it is necessary to know the drag area change, the true airspeed, the pressure altitude and the free air temperature. Enter at the known drag area change, move right to TAS, move down to pressure altitude, move left to FAT, then move down and read change in torque. In addition, by entering the chart in the opposite direction, drag area change may be found from a known torque change.

7-32. Conditions.

The drag chart is based on 324 rotor/6600 engine rpm.

Section IX. CLIMB — DESCENT AND LANDING

7-33. Description — Climb-Descent Chart.

The upper grid of the climb-descent chart (figure 7-10) shows the change in torque (above or below torque required for level flight under the same gross weight and atmospheric conditions) to obtain a given rate of climb or descent. The lower grid of the chart shows the relationships between descent-climb angles, airspeeds, and rates of descent or climb.

7-34. Use of Climb-Descent Chart.

The primary uses of the chart are illustrated by the chart examples.

a. The torque change obtained from the upper grid scale must be added to the torque required for level flight (for climb) - or subtracted from the torque required for level flight (for descent) - obtained from the appropriate cruise chart in order to obtain a total climb or descent torque.

b. By entering the bottom of the upper grid with a known torque change, moving upward to the gross weight, and left to the corresponding rate of climb or descent may also be obtained.

c. By entering the lower grid chart with any two of the three parameters (rate of climb/descent, descent climb angle, or airspeed) the third parameter can be read directly from the chart. For example, by entering the chart with a known TAS of 65 knots moving upward to a known climb angle of nine degrees, and then moving left, the corresponding rate of climb (1025 feet per minute) is obtained.

7-35. Conditions.

The climb-descent chart is based on the use of 324 rotor/6600 engine rpm.

Section X. IDLE FUEL FLOW

7-36. Description.

The idle fuel flow chart (figure 7-11) shows the fuel flow at engine idle and at flat pitch with 324 rotor RPM.

7-37. Use of Chart.

The primary use of the chart is illustrated by the example. To determine the idle fuel flow, it is necessary to know the idle condition, pressure altitude, and free air temperature. Enter at the pressure altitude, move right to FAT in appropriate grid, then move down and read fuel flow on the scale corresponding to the condition. Refer to the cruise charts to obtain fuel flow for cruise power conditions.

7-38. Conditions.

This chart is based on the use of JP-4 fuel and 324 rotor/6600 engine rpm.

Section XI. AIRSPEED CALIBRATION

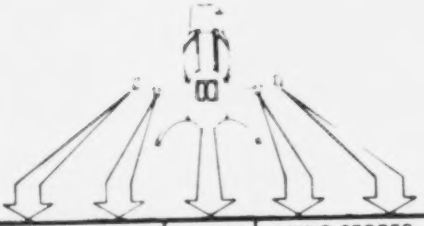
7-39. Description.

The airspeed calibration chart (figure 7-12) shows the difference between indicated and calibrated airspeeds.

7-40. Use of Chart.

The primary use of the chart is illustrated by the example. To determine calibrated airspeed, it is necessary to know the indicated airspeed. Enter the chart at the indicated airspeed for the applicable performance condition, move right to the curve, then down and read calibrated airspeed. In addition, by entering the chart in the opposite direction, calibrated airspeed may be converted to indicated airspeed.

EQUIVALENT FLAT PLATE DRAG AREA



ΔF — SQ FT		WING STORES		TURRET	WING STORES		REF
4 TOW	8 TOW						
0	-3.0	G		A		G	1
+3.0	0	D		A		D	2
-3.5	-6.5			A			3
+4.1	+1.1	G	B	A	B	G	4
+1.3	-1.7	G	E	A	E	G	5
+2.3	-0.7	G	F	A	F	G	6
+8.6	+5.6	D	B	A	B	D	7
+4.5	+1.5	D	E	A	E	D	8
+4.8	+1.8	D	F	A	F	D	9
-0.4	-3.4		B	A	B		10
-0.3	-3.3	B		A		B	11
-2.5	-5.5		E	A	E		12
-2.2	-5.2		F	A	F		13
-2.1	-5.1	F		A		F	14
+4.2	+1.2	B	B	A	B	B	15
-0.2	-3.2	F	F	A	F	F	16
+1.7	-1.3	F	B	A	B	F	17

ADD ΔF = 2.0 SQ FT FOR LOW REFLECTIVE IR PAINT TO ANY CONFIGURATION

DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 66-06, APRIL 1970 AND USA ASTA 72-43, JULY 1973

A A

TURRET — M28A1E1 (7.62 MM GUN/40MM GRENADE)

B B

ROCKET LAUNCHER — M159 (19 TUBE)
M200 (19 TUBE)

C C

SMOKE GRENADE DISPENSER — M118

D D

M65 — TWO LAUNCHERS (FOUR MISSILES)

E E

WING GUN POD — M18 (7.62MM GUN) OR M18A1 (7.62MM GUN)

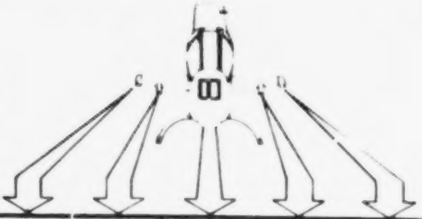
F F

ROCKET LAUNCHER — M157 (7 TUBE)
M158 (7 TUBE)

G G

TOW MISSILE — M65 — ONE LAUNCHER (TWO MISSILES)

Figure 7-9. Drag (Authorized armament configurations) chart (Sheet 1 of 3)



EQUIVALENT FLAT PLATE DRAG AREA

ΔF — SQ FT		WING STORES		TURRET	WING STORES		REF
4 TOW	8 TOW						
+1.8	−1.2	B	F	A	F	B	18
+1.5	−1.5	B	E	A	E	B	19
−1.0	−4.0	F	E	A	E	F	20
−1.5	−4.5	C		A		C	21
+2.6	−0.4	C	B	A	B	C	22
−0.4	−3.4	C	E	A	E	C	23
+0.8	−2.2	C	F	A	F	C	24
+6.4	+3.4	B C	B	A	B	B C	25
+3.8	+0.8	B C	F	A	F	B C	26
+3.5	+0.5	B C	E	A	E	B C	27
+3.7	+0.7	F C	B	A	B	F C	28
+1.0	−2.0	F C	E	A	E	F C	29
+1.8	−1.2	F C	F	A	F	F C	30

ADD Δ F = 2.0 SQ FT FOR LOW REFLECTIVE IR PAINT TO ANY CONFIGURATION

DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 66-06, APRIL 1970 AND USA ASTA 72-43, JULY 1973

A

TURRET — M28A1E1 (7.62 MM GUN/40MM GRENADE)

B

ROCKET LAUNCHER — M200 (19 TUBE)

C

SMOKE GRENADE DISPENSER — M118

D

M65 — TWO LAUNCHERS (FOUR MISSILES)

E

WING GUN POD — M18 (7.62MM GUN) OR M18A1 (7.62MM GUN)

F

ROCKET LAUNCHER — M158 (7 TUBE)

G

TOW MISSILE — M65 — ONE LAUNCHER (TWO MISSILES)

Figure 7-9. Drag (Authorized armament configurations) chart (Sheet 2 of 3)

DRAG

EXAMPLE

WANTED

CHANGE IN TORQUE REQUIRED DUE TO EQUIVALENT FLAT PLATE DRAG AREA CHANGE, (△F) FROM CONFIGURATION NO 1 TO CONFIGURATION NO 29 WITH IR PAINT

KNOWN (FROM FIGURE 7-9 SHEET 1)

DRAG AREA CHANGE = 3.0 SQ FT
TRUE AIRSPEED = 140 KNOTS
PRESSURE ALTITUDE = SEA LEVEL
FAT = 40°C

METHOD

ENTER DRAG AREA CHANGE HERE
MOVE RIGHT TO TRUE AIRSPEED
MOVE DOWN TO PRESSURE ALTITUDE
MOVE LEFT TO FAT
MOVE DOWN, READ CHANGE IN TORQUE = 4.7 PSIG

DATA BASIS: CALCULATED DATA

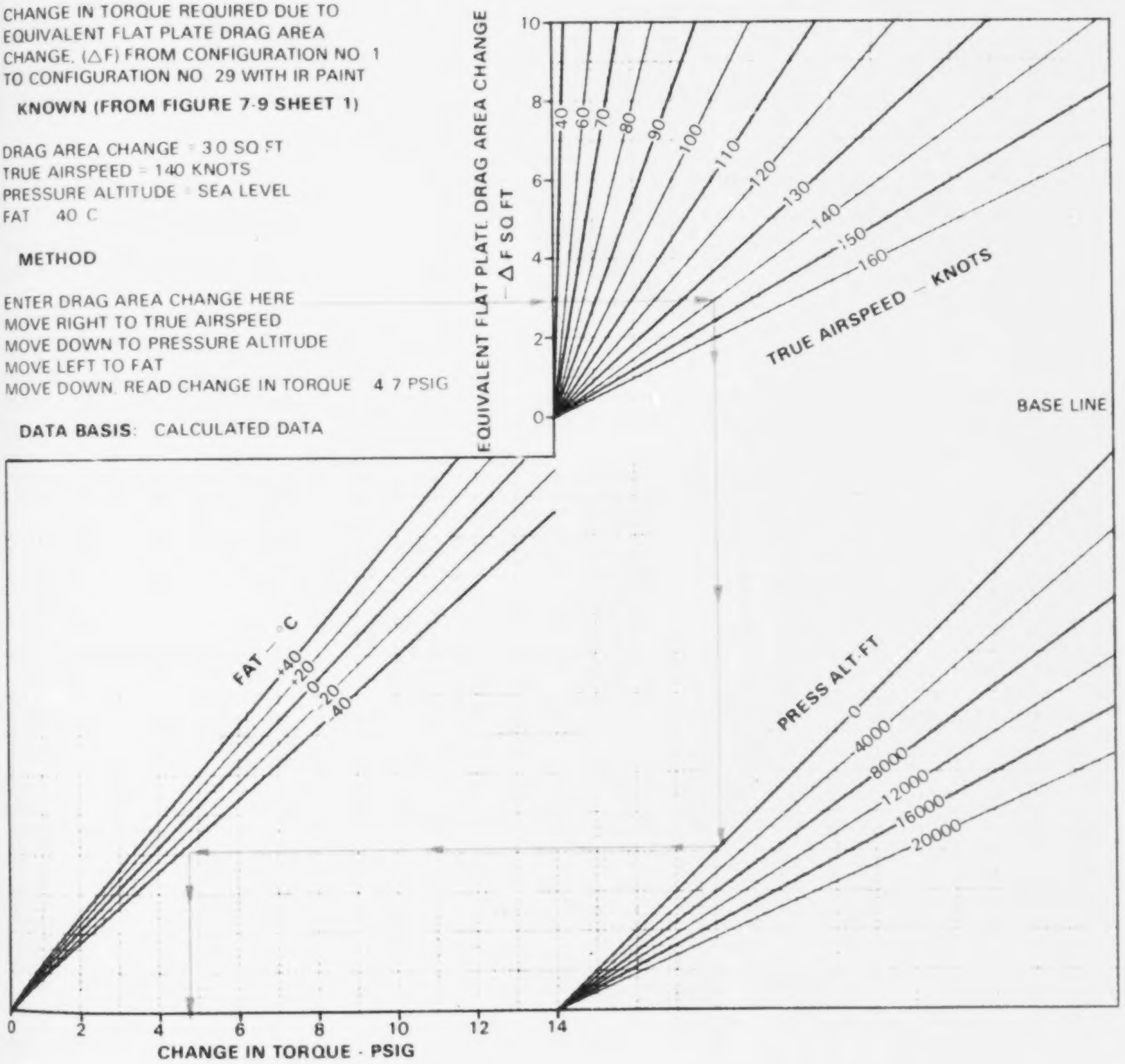


Figure 7-9. Drag chart (Sheet 3 of 3)

CLIMB — DESCENT

324 ROTOR/6600 ENGINE RPM

CLIMB — DESCENT
AH-1S
T53-L-703

EXAMPLE A

WANTED

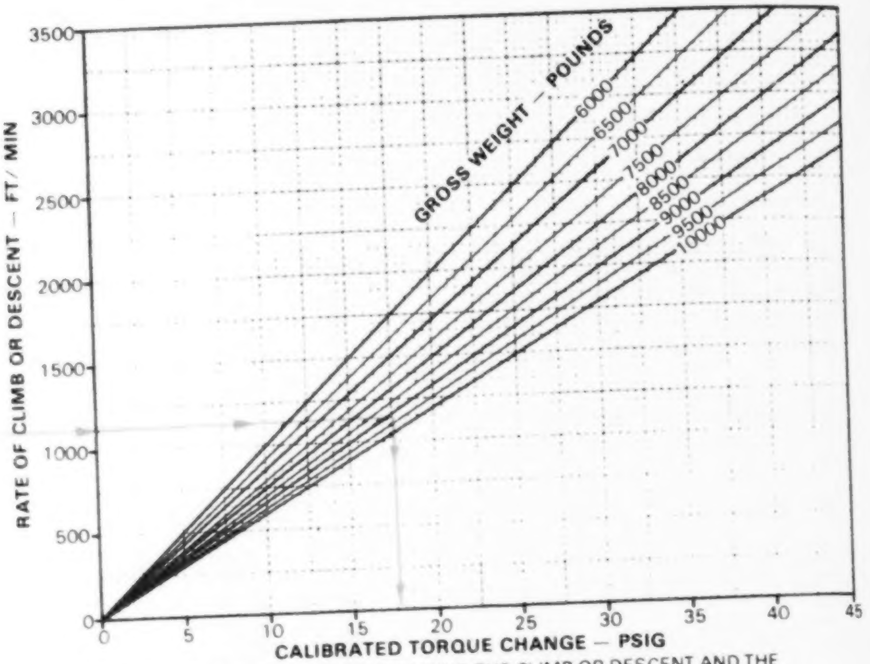
CALIBRATED TORQUE CHANGE FOR DESIRED R/C OR R/D

KNOWN OR ESTIMATED

GROSS WEIGHT = 9500 LB
DESIRED R/C = 1100 FT/MIN

METHOD

ENTER R/C HERE
MOVE RIGHT TO GROSS WEIGHT
MOVE DOWN, READ CALIBRATED TORQUE CHANGE = 17.5 PSIG



REMARK: TORQUE CHANGE IS THE DIFFERENCE BETWEEN THE TORQUE USED DURING THE CLIMB OR DESCENT AND THE TORQUE REQUIRED FOR LEVEL FLIGHT AT THE SAME CONDITIONS (ALTITUDE, GROSS WEIGHT, AIRSPEED, CONFIGURATION, ETC)

EXAMPLE B

WANTED

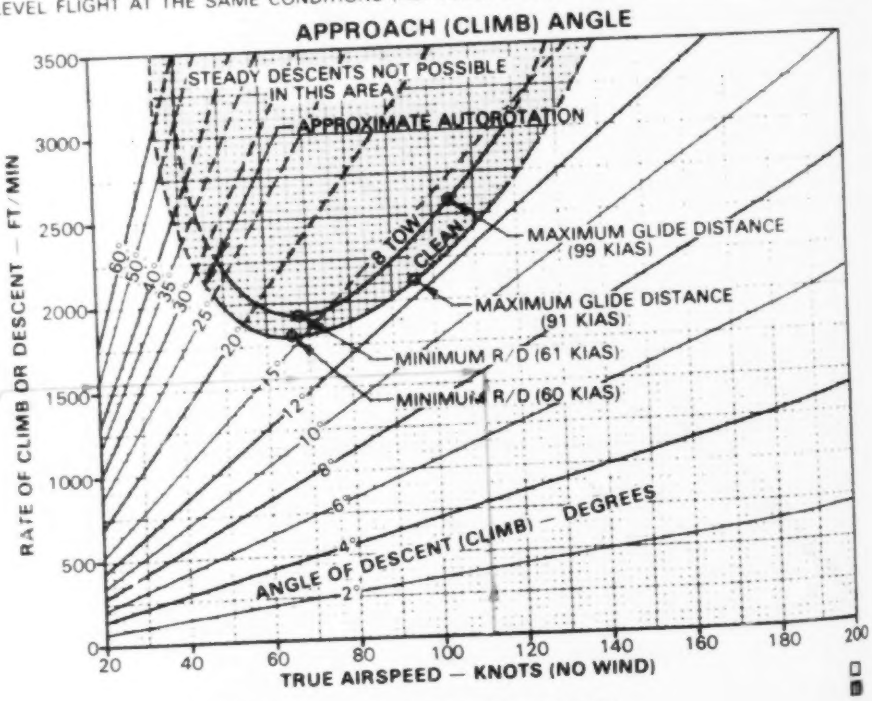
DESCENT ANGLE

KNOWN OR ESTIMATED

DESIRED R/D = 1550 FT/MIN
TAS = 110 KNOTS

METHOD

ENTER R/D HERE
MOVE RIGHT TO 85 KN TAS
READ ANGLE OF DESCENT = 8°



DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 72-43, JULY 1973 AND CALCULATED DATA

Figure 7-10. Climb — descent chart

IDLE FUEL FLOW

JP-4 FUEL

INSTALLATION LOSSES INCLUDED

IDLE FUEL FLOW
AH-1S
T53-L-703

EXAMPLE

WANTED

FUEL FLOW AT GROUND IDLE AND AT 324 ROTOR/6600 ENGINE RPM WITH FLAT PITCH

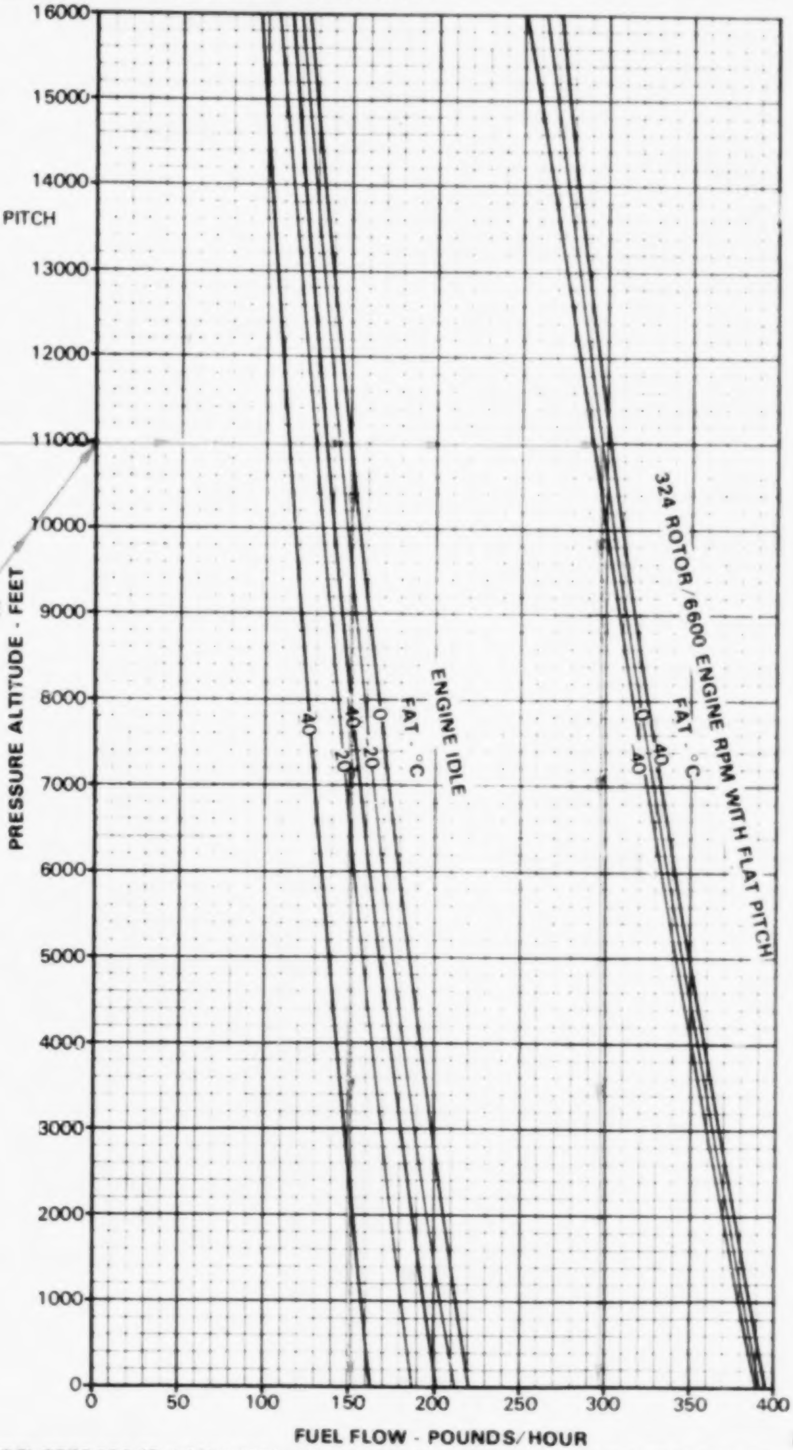
KNOWN

PRESSURE ALTITUDE = 11000 FEET
FAT = 0°C

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO (ENGINE IDLE) FAT
MOVE DOWN, READ ENGINE IDLE
FUEL FLOW = 150 LB/HR

REENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO (324 ROTOR/6600 ENGINE RPM WITH FLAT PITCH) FAT
MOVE DOWN, READ 324 ROTOR/6600 ENGINE RPM WITH FLAT PITCH FUEL
FLOW = 297 LB/HR



DATA BASIS: CALCULATED FROM MODEL SPEC 104.43, 1 MAY 1974. CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST, USA ASTA 66-06, APRIL 1970

Figure 7-11. Idle fuel flow chart

AIRSPEED CALIBRATION

ROOF MOUNTED SYSTEM

AUTOROTATION LEVEL FLIGHT DESCENT DIVE

ALL CONFIGURATIONS

EXAMPLE

WANTED

CALIBRATED AIRSPEED
INDICATED AIRSPEED

KNOWN

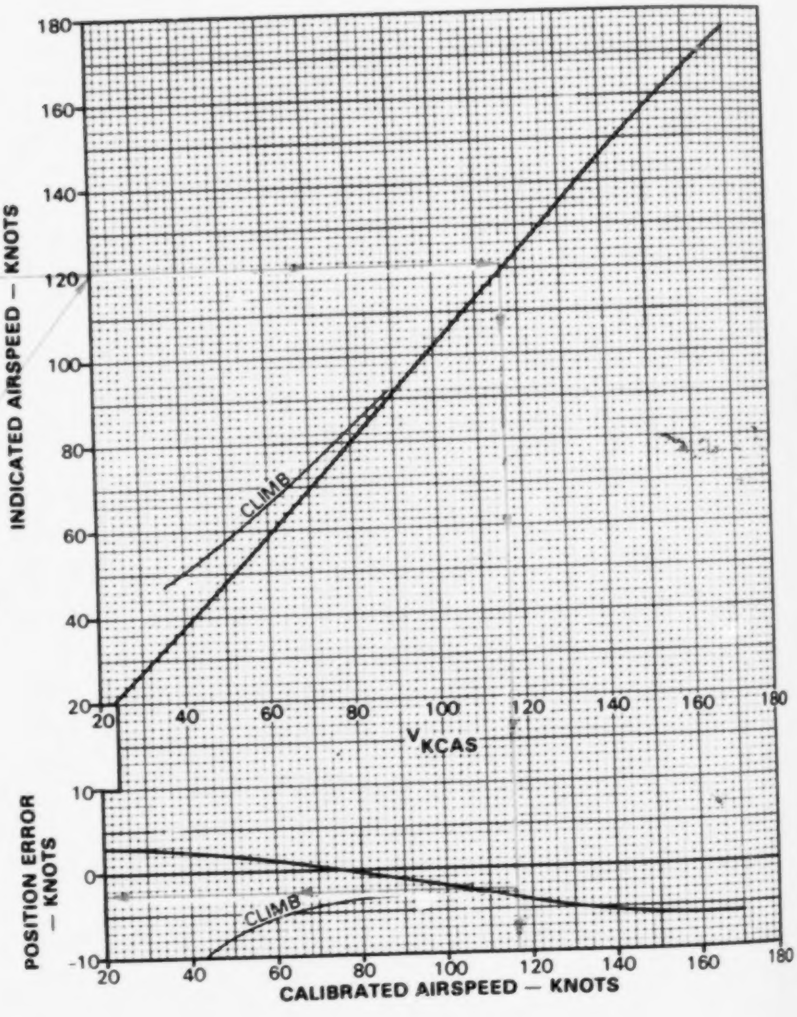
CAS = IAS + POSITION ERROR
FLIGHT CONDITION = LEVEL FLIGHT
INDICATED AIRSPEED = 120 KNOTS

METHOD A

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO DIAGONAL LINE
MOVE DOWN, READ CALIBRATED AIRSPEED = 116.5 KNOTS

METHOD B

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO DIAGONAL LINE
MOVE DOWN TO DIAGONAL LINE
MOVE LEFT, READ POSITION ERROR = -3.5 KNOTS
CALIBRATED AIRSPEED = (120 - 3.5) = 116.5 KNOTS



DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 72-43, JULY 1973

Figure 7-12. Airspeed calibration chart

CHAPTER 8

NORMAL PROCEDURES

Section I. MISSION PLANNING

8-1. MISSION PLANNING.

Mission planning begins when the mission is assigned and extends to the preflight check of the helicopter. It includes, but is not limited to, check of operating limits and restrictions; weight/balance and loading; performance; publications; flight plan and crew briefings. The pilot in command shall ensure compliance with the contents of this manual that are applicable to the mission.

8-2. AVIATION LIFE SUPPORT EQUIPMENT (ALSE).

All aviation life support equipment required for mission; e.g., helmets, gloves, survival vests, survival kits, etc., shall be checked.

8-3. CREW DUTIES/RESPONSIBILITIES.

The minimum crew required to fly the helicopter is a pilot. Additional crewmembers, as required, may be added at the discretion of the commander. The manner in which each crewmember performs his related duties is the responsibility of the pilot in command.

a. Pilot. The pilot in command is responsible for all aspects of mission planning, preflight, and operation of the helicopter. He will assign duties and functions to all other crewmembers as required. Prior to or during preflight, the pilot will brief the crew on the mission, performance data, monitoring of instruments, communications, emergency procedures, and armament procedures.

b. Copilot (when assigned). The copilot must be familiar with the pilot's duties and the duties of the other crew positions. The copilot will assist the pilot as directed.

c. Crew Chief (when assigned). The crew chief will perform all duties as assigned by the pilot.

8-4. CREW BRIEFING.

A crew briefing shall be conducted to ensure a thorough understanding of individual and team responsibilities. The briefing should include, but not be limited to, copilot, mission equipment operator, and ground crew responsibilities and the coordination necessary to complete the mission in the most efficient manner. A review of visual signals is desirable when ground guides do not have a direct voice communications link with the crew.

8-5. PASSENGER BRIEFING.

The following is a guide that should be used in accomplishing required passenger briefings. Items that do not pertain to a specific mission may be omitted.

a. Crew introduction

b. Equipment.

  (1) Personal to include ID tags.

  (2) Professional.

  (3) Survival.

c. Flight Data.

  (1) Route.

  (2) Altitude.

  (3) Time en route.

  (4) Weather.

d. Normal Procedures.

  (1) Entry and exit of helicopter.

  (2) Seating.

  (3) Seat belts.

  (4) Movement in helicopter.

  (5) Internal communications.

  (6) Security of equipment.

  (7) Smoking.

  (8) Oxygen.

(9) Refueling.

(10) Weapons.

(11) Protective masks.

(12) Parachutes.

(13) Ear protection.

(14) ALSE.

e. Emergency Procedures.

(1) Emergency exits.

(2) Emergency equipment.

(3) Emergency landing/ditching procedures.

8-6. DANGER AREAS.

Refer to Figure 8-1.

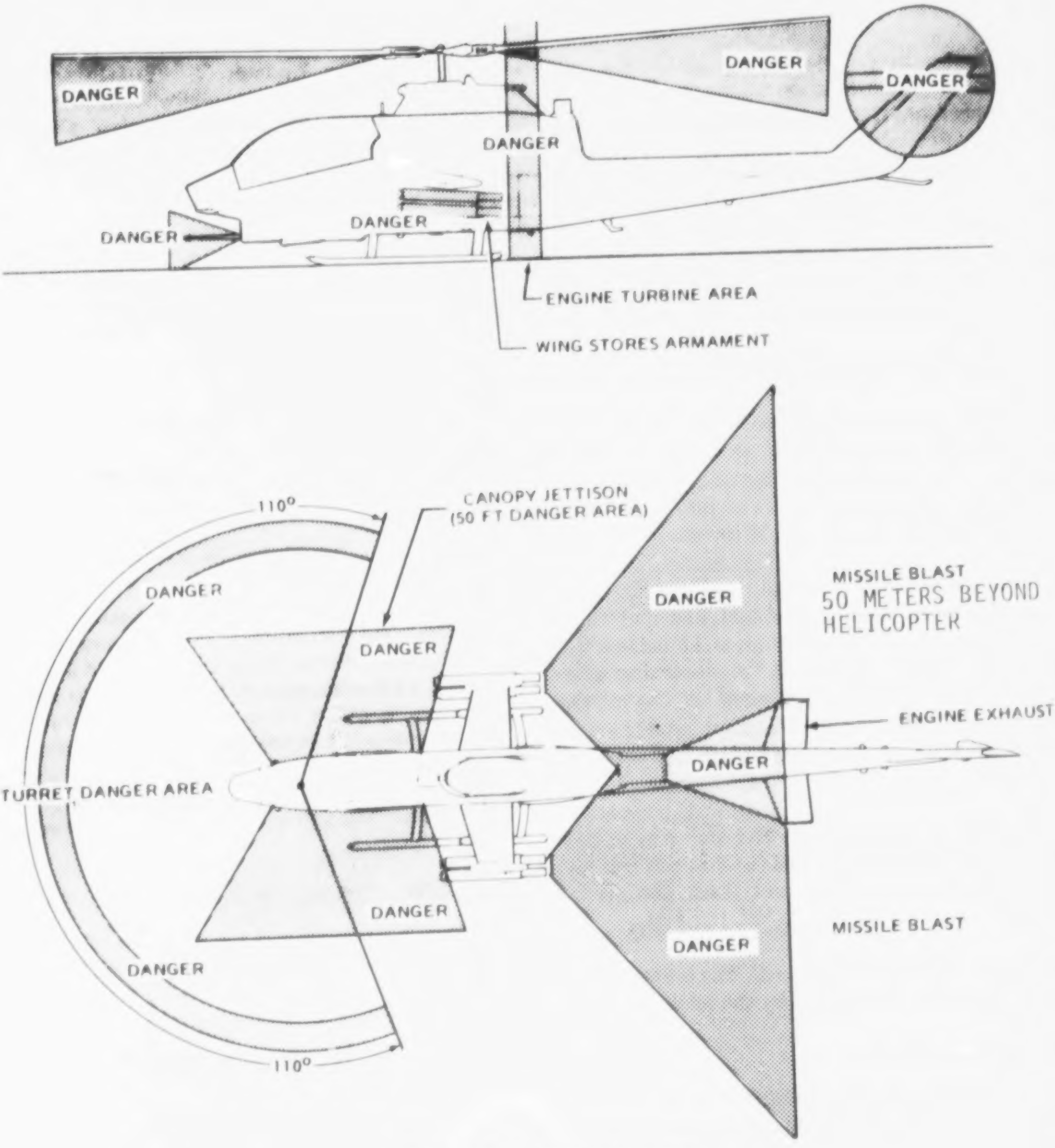

DANGER
DANGER
DANGER
DANGER
DANGER
DANGER
ENGINE TURBINE AREA
WING STORES ARMAMENT
110°
CANOPY JETTISON (50 FT DANGER AREA)
DANGER
DANGER
DANGER
MISSILE BLAST
50 METERS BEYOND HELICOPTER
ENGINE EXHAUST
DANGER
TURRET DANGER AREA
DANGER
DANGER
MISSILE BLAST
DANGER
110°

Figure 8-1. Danger areas.

Section II. OPERATING PROCEDURES AND MANEUVERS

8-7. OPERATING PROCEDURES AND MANEUVERS.

This section deals with normal procedures and includes all steps necessary to ensure safe and efficient operation of the helicopter from the time a preflight begins until the flight is completed and the helicopter is parked and secured. Unique feel, characteristics, and reaction of the helicopter during various phases of operation and the techniques and procedures used for hovering, takeoff, climb, etc., are described, including precautions to be observed. Your flying experience is recognized; therefore, basic flight principles are avoided. Only the duties of the minimum crew necessary for the actual operation of the helicopter are included.

8-8. MISSION EQUIPMENT CHECKS.

Mission equipment checks are contained in Chapter 4, MISSION EQUIPMENT. Descriptions of functions, operations, and effects of controls are covered in Section IV, FLIGHT CHARACTERISTICS, and are repeated in this section only when required for emphasis. Checks that must be performed under adverse environmental conditions, such as desert and cold weather operations, supplement normal procedures checks in this section and are covered in Section V, ADVERSE ENVIRONMENTAL CONDITIONS.

8-9. SYMBOLS DEFINITION.

The checklist includes items with annotative indicators immediately preceding the check to which they are pertinent; O to indicate a requirement if the equipment is installed. The symbol ★ indicates that a detailed procedure for the step is located in the performance section of the condensed checklist. When a helicopter is flown on a mission requiring intermediate stops, it is not necessary to perform all of the normal checks. The steps that are essential for safe helicopter operations on intermediate stops are designated as "thru-flight" checks. An asterisk indicates that performance of steps is mandatory for all "thru-flights" when there has been no change in pilot-in-command. The asterisk applies only to checks performed prior to takeoff.

8-10. CHECKLIST.

Normal procedures are given primarily in checklist form and amplified as necessary in accompanying paragraph form when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operators and Crewmembers Checklist, TM 55-1520-234-CL.

8-11. PREFLIGHT CHECK.

The pilot's walk-around and interior checks are outlined in the following procedures. The preflight check is not intended to be a detailed mechanical inspection. The steps that are essential for safe hellicopter operation are included. The preflight may be made as comprehensive as conditions warrant at the discretion of the pilot.

8-12. BEFORE EXTERIOR CHECKS.

WARNING

Do not preflight until armament systems are safe.

★*1. Armament systems—Check as follows:

a. Wing ejector racks—Jettison safety pins installed.

b. TOW launcher—Missile arming lever up.

c. Rocket launcher—Igniter arms in contact with rockets.

d. MASTER ARM switch—OFF.

(O) e. SMOKE switches—OFF.

f. PLT OVRD switch—OFF.

g. WG ST ARM switch—OFF.

h. TURRET Weapons—SAFE.

*2. Canopy removal arming/firing mechanism safety pins—IN.

*3. Publications—Check in accordance with DA PAM 738-751 and any locally required forms and publications.

4. BAT switch—ON. A minimum of 22 volts indicates satisfactory condition to attempt battery start.

5. NON-ESS BUS switch—MANUAL.

6. Lights—Check if use is anticipated.

7. BAT switch—OFF.

8. Pilot's HSS linkage assembly—Check condition and stow.

9. Area behind pilot seat—Check as follows:

   a. First aid kit.

   b. Sensor amplifier unit.

   c. HSS interface assembly.

(O) d. Pylon compensator unit.

10. Map light—OFF.

*11. Canopy—Check.

8-13. EXTERIOR CHECK (figure 8-2).

8-14. AREA 1.

*1. Fuel—Check quantity and condition of grounding receptacle. Secure cap.

*2. Fuel sample—Check for contamination before first flight of the day. If the fuel sumps and filter have not been drained, drain and check as follows:

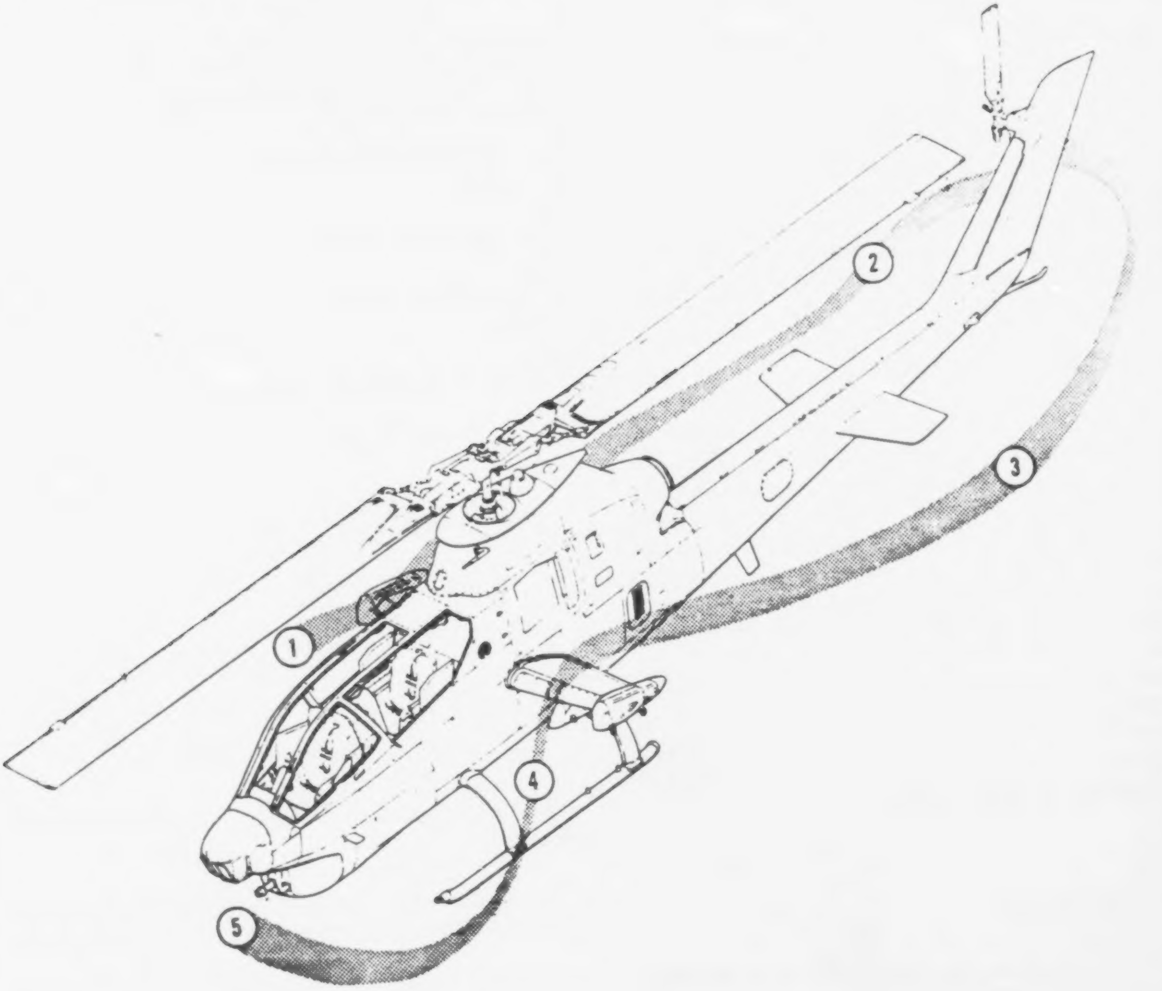


Figure 8-2. Exterior check diagram.

*14. Pylon access — Check condition and security of FM antenna and engine oil reservoir. Check oil level by removing cap; then secure cap.

15. Swashplate and support — Check condition and security of collective levers, antidrive link, swashplate drive links, scissors levers, and friction collet.

a. Sumps—Drain.

b. BAT switch—ON.

c. FUEL switch—FUEL.

d. Filter—Drain.

e. FUEL switch—OFF.

f. BAT switch—OFF.

***3. Main rotor blade/Root end fitting inboard surface—Check.**

4. Fuselage—Check as follows:

a. Window channel assembly—Check.

(0) b. Window deflectors and upper cutter assembly—Check.

c. Static port—Check.

*5. Ammunition bay (right side)—Check condition of door, loading security, and electrical wiring/connections. Check hydraulic lines and following if installed:

(0) a. Ammunition drum—Check.

(0) b. Flexible shaft—Check.

(0) c. Ammunition chute—Check.

*6. Hydraulic compartment—Check condition of lines, reservoir, cap, and ECU. Check electrical connectors and filter buttons in.

7. Landing gear—Check.

8. Area beneath transmission—Check condition of lines, controls, and electrical connectors. Check accumulator for proper charge.

9. Wing—Check.

10. Armament—Check as follows:

(0) a. TOW—Check.

(0) b. Rocket launcher—Check.

(0) c. Wing gun pod—Check.

11. Engine and transmission cowlings—Secure open.

*12. Transmission area—Check hydraulic pumps, lines, servo, transmission oil level, filter button in and main drive shaft.

*13. Pylon access—Check engine oil reservoir, oil level, and electrical connectors.

*14. Swashplate and support—Check.

*15. Main rotor system—Check.

*16. Plenum and particle separator—Check for FOD and check area beneath plenum.

17. Engine compartment—Check air intake, condition of fuel and oil lines, and fire detector sensing elements. Close cowlings.

18. Fuselage—Check.

8-15. AREA 2.

1. Tailpipe—Check.

2. Electrical compartment—Check battery, vents, tailboom attaching bolts for slippage marks and circuit breakers in.

3. Right side tailboom—Check as follows:

a. Air ejector area—Check.

b. Skin—Check.

c. Synchronized elevator—Check.

d. Antennas—Check.

e. Position light—Check.

f. Tail skid—Check.

*4. 42 degree gearbox—Check oil level and cap secure.

*5. Main rotor blade—Check.

*6. Tail rotor—Check.

8-16. AREA 3.

*1. 90-degree gearbox—Check oil level, and cap secure.

2. Left side tailboom—Check as follows:

   a. Position light—Check.

   b. Tail rotor drive shaft—Check.

   c. Skin—Check.

   d. Antennas—Check.

   e. Synchronized elevator—Check.

   f. Air ejector area—Check.

3. Oil cooler compartment—Check.

8-17. AREA 4.

1. Engine and transmission cowling—Secured open. Check engine air intake, condition of fuel and oil lines, fire detector sensing elements, and electrical connectors.

*2. Plenem and particle separator—Check for FOD and area beneath plenum.

3. Tail rotor driveshaft—Check.

4. Transmission area—Check lines, servo, and lift link.

5. Pylon access—Check engine oil reservoir and FM antenna.

6. Swashplate and support—Check.

7. Top pylon area—Check as follows:

   a. Anti-collision light—Check.

   b. Pitot tube—Check.

   (O) c. Upper cutter assembly—Check.

8. Main rotor system—Check.

9. Engine and transmission cowlings—Closed.

10. Wing—Check.

(O) 11. Armament—Check as follows:

   a. TOW—Check.

   b. Rocket launcher—Check.

   c. Wing gun pod—Check.

12. Area beneath transmission—Check controls and condition of hydraulic, oil, and fuel lines.

13. Landing gear—Check as follows:

   a. Skids and crosstubes—Check.

   b. Skid landing light—Check.

14. Lower fuselage—Check as follows:

   a. Searchlight—Check.

   (O) b. Lower cutter assembly—Check.

*15. Hydraulic compartment—Check condition of lines, reservoir cap, electrical connectors, and ECU. Check fluid levels and filter buttons in.

16. Canopy—Check. (If single pilot—Perform checks in paragraph 8-20.)

17. Fire extinguisher—Check.

18. Fuselage—Check.

19. Static port—Check.

*20. Ammunition bay (left side)—Check condition of door, electrical connection, hydraulic lines, and LCHR boresight switch—OFF. Check following if installed:

   (O) a. Ammunition drum—Check.

   (O) b. Ammunition chute—Check.

   (O) c. Electrical cables/connectors—Check.

8-18. AREA 5.

1. Turret—Check. Refer to Chap 4.

2. Windshield and rain removal nozzles—Check.

(O) 3. Lower cutter assembly, chin cutter assembly and nose deflector—Check.

*8-19. WALK-AROUND CHECK.

1. Cowling, doors, and panels—Secure.

2. Covers, tiedown, and grounding cables—Removed and secured. Rotate main rotor 90 degrees.

(O) 3. Wing store safety pins—Remove.

(O) 4. TOW launcher missile arming lever—Check down.

5. Crew or passenger briefing—Complete.

8-20. BEFORE STARTING ENGINE—GUNNER STATION.

*1. Cockpit—General.

a. Seat belt and shoulder harness—Secure.

b. Loose equipment—Secure.

2. HSS—Check and stow.

*3. Miscellaneous control panel switches—Set as follows:

a. ELEC PWR switch—ELEC PWR.

b. ENG DE-ICE switch—OFF.

c. GOV switch—AUTO.

*4. EMER COLL HYD switch—OFF.

*5. WING STORES JETTISON switch—OFF and lockwired.

6. Avionics—As required.

*7. System/flight instruments—Check condition, security, and static indications.

8. Standby compass—Full of fluid and deviation card current.

★ * 9. Armament switches—Set as follows:

a. Gunner SHC ACO/TRK/STOW switch—STOW.

b. Gunner TCP MODE SELECT switch—OFF; system status annunciator displays OFF.

c. Gunner TCP CAMERA switch—OFF.

d. Gunner TCP TSU RTCL switch—OFF.

e. Gunner TCP MISSILE SELECT switch—as desired.

f. Gunner AMMO RSV PERCENT dials—Set.

g. TURRET DEPR LIMIT switch—DEPR LIMIT.

10. Map light—OFF.

*11. Canopy removal arming/firing mechanism safety pin—Remove and stow (if occupied).

8-21. BEFORE STARTING ENGINE—PILOT STATION.

*1. IGNITION SW—ON.

*2. Collective friction and lock—OFF.

*3. AC circuit breakers—As required.

4. PWR panel switches—Set as follows:

*a. BAT switch—ON.

b. GEN switch—OFF.

c. INV switch—OFF.

d. NON ESS BUS switch—As desired.

*e. MISC PRESS TEST switch—Press.

5. ENGINE panel switches—Set as follows:

a. DEICE switch—OFF.

b. FORCE TRIM switch—TRIM.

c. HYD TEST switch—Centered (Both systems on).

*d. FUEL switch—ON. Check boost pump lights out.

e. ENG OIL BYP switch—AUTO.

f. GOV switch—AUTO.

6. FAT gauge—Check condition.

7. SCAS POWER switch—OFF.

8. System instruments—Check condition, range markings, and static indications.

9. Collective accumulator switch—OFF.

10. WING STORES JETTISON switch—Cover down and lockwired.

11. Compass switch—MAG.

12. Clock—Set.

13. Flight instrument—Check and set as required.

*14. Altimeter—Set.

15. M73 sight—Check.

✱16. Armament switches—Set.

a. WPNS CONTR—gunner.

b. RKT PR SEL switch—As desired.

c. Smoke grenade dispenser—Set.

d. PSI—Check.

17. CODE HOLD switch—OFF.

*18. FIRE DETECTOR TEST switch—TEST.

19. PITOT HEAT switch—OFF.

20. RAIN REMOVAL/ENVR CONT switch—OFF.

21. HEAT or VENT AIR pull knob—Out and vents adjust.

*22. MASTER CAUTION and RPM warning lights—Check illuminated.

*23. Caution panel lights—TEST and RESET MASTER CAUTION light.

24. Avionics—OFF; set as desired.

25. Light switches—Set as required.

*26. DC circuit breakers-In, except TOW BLOW.

*27. Canopy removal arming/firing mechanism safety pin—Remove and stow.

*8-22. STARTING ENGINE.

WARNING

When helicopter is armed with rockets, make start with battery only, because it is hazardous to place GPU (or any electrical generating equipment) in close proximity due to danger of accidental firing of rockets.

1. GPU—Connect if GPU starting. (BAT switch—OFF.)

2. Throttle—Check and set for start.

3. Fireguard—Posted.

4. Rotor blades—Check clear and untied.

✱5. Engine—Start as follows:

a. Start switch—Press and hold (start time).

b. Main rotor—Check turning as N1 reaches 15 percent. If not, abort the start.

c. Start switch—Release at 40 percent N1 or after 35 seconds, whichever occurs first.

d. IGN SYS circuit breaker—OUT, at 750 degrees C TGT.

e. GEN switch—ON, at 60 percent N1.

f. INV switch—STBY for first flight of day and MAIN for thru-flight.

g. Throttle—Slowly advance past the engine idle stop to engine idle position. Check stop by attempting to roll throttle off.

h. N1—Check 68 percent to 72 percent. Hold a slight pressure against the idle stop during this check.

i. IGN SYS circuit breaker—IN after TGT has stabilized.

6. GPU—Disconnect after GPU start.

7. BAT switch—ON.

8. Systems—Check as follows:

a. Engine and transmission oil ppressures—Check.

b. Caution lights—Check off.

c. Ammeter—Check less than 200 amps.

CAUTION

Oil pressure may exceed maximum on low ambient temperature starts. Do not exceed engine idle until engine oil pressure is below 100 psi.

8-23. ENGINE RUNUP.

CAUTION

Minimize movement of the cyclic during ground runup to preclude damage to the input quill seal and the main driveshaft.

*1. Avionics/mission equipment—On as desired.

*2. SCAS POWER switch—POWER (check NO-GO lights illuminate, and remain on for approximately 10 seconds, then extinguish prior to 30 seconds).

3. Hydraulic system—Check as follows:

a. FORCE TRIM switch—OFF.

b. HYD TEST switch—SYS 1 (system 2 out); MASTER CAUTION and #2 HYD PRESS caution lights should illuminate; all controls should be free.

c. HYD TEST switch—SYS 2 (system 1 out), MASTER CAUTION and #1 HYD PRESS caution lights should illuminate, pedals will be stiff but movable, cyclic and collective free.

d. HYD TEST switch—Center position, #1 and #2 HYD PRESS caution lights should be out.

e. FORCE TRIM switch—FORCE TRIM.

*4. Canopy doors—Secure.

*5. Throttle — 6600. As throttle is increased, the low rpm audio and light should be off at 6200 ± 100 rpm. Throttle friction as desired.

6. Deleted.

*7. Systems—Check as follows:

a. Fuel quantity—Check and depress FUEL GAGE TEST switch.

b. Engine instruments—Check.

c. Transmission instruments—Check.

d. DC voltmeter—Check at 27.5 ±0.25 volts.

e. INV switch - MAIN (INST INVERTER light out).

f. DEICE switch—Check as required.

g. Pitot heater—Check as required.

*8. SCAS—Check as follows:

a. NO-GO lights—Check out.

NOTE

If the mechanically dimmable NO-GO lights are dimmed, a false indication could result in engagement of SCAS with an out-of-null condition.

b. Engage PITCH, ROLL, and YAW channels one at a time and visually check around the helicopter. Have hand on the cyclic stick, and be prepared to immediately press the SAS REL switch if any abnormal tip path or control fluctuations are noted.

c. Press the SAS REL switch on gunner's cyclic and pilot checks channels are OFF.

d. Pilot checks NO-GO lights are out and reengages PITCH, ROLL, and YAW channels; then, press the SAS REL switch on his cyclic. Check channels are OFF.

e. Pilot checks NO-GO lights are out and reengages PITCH, ROLL, and YAW channels.

*9. Armament systems—Set as follows:

a. MASTER ARM—STBY.

b. TCP switch—STBY TOW.

c. TOW BLOW circuit breaker—IN.

*10. Avionics/mission equipment—Check and set as required.

*11. Altimeters—Set the radar altimeter and current barometric pressure.

*12. RMI—Corresponds with standby compass. Set as required.

*13. Attitude indicator—Set.

★ 14. Armament systems—Check as follows:

a. HSS built-in-test—Check.

b. HSS to turret—Check.

c. HSS to TSU—Check.

d. TOW built-in-test—Check.

e. TSU fast rate tracking—Check.

f. TSU slow rate tracking—Check.

g. TSU motion compensation—Check.

h. TSU to turret—Check.

i. M73 sight—ON and check.

15. Health Indicator Test (HIT) check—Perform as required on first flight of the day.

★ *16. Armament switches—Set as follows:

a. Gunner PLT OVRD switch—OFF.

b. Pilot MASTER ARM switch—STBY.

c. TCP—TSU/GUN.

d. TOW launchers—Missile arming lever down.

e. Wing ejector rack jettison safety pins—Removed.

f. Other switches—Set for mission rqmts.

*8-24. HOVER CHECK.

Perform the following checks at a hover:

1. Flight controls—Check for correct position and response.

2. Engine and transmission instruments—Check.

3. Flight instruments—Check as required.

a. Airspeed indicator—Check airspeed.

b. Attitude indicator—Indicates nose high or low and banks left and right.

c. VSI and altimeter—Indicate climb and descent.

d. Slip indicator—Ball free in race.

e. Turn needle, RMI, and magnetic compass indicate turns left and right.

4. Power—Check. The power check is performed by comparing the indicated torque required to hover with the predicted values from performance charts.

*8-25. BEFORE TAKEOFF

1. RPM—6600.

2. Systems—Check engine, transmission, electrical, and fuel systems indications.

3. Avionics—As required.

4. Mission equipment—Set as required.

5. Armament switches—Set.

8-26. MAXIMUM PERFORMANCE.

A takeoff that demands maximum performance from the helicopter is necessary because of various combinations of heavy helicopter loads, restricted performance due to high density altitudes, barriers that must be cleared and other terrain features. The decision to use either of the following takeoff techniques must be based on an evaluation of the conditions and helicopter performance.

a. Coordinated Climb (maximum performance). Align the helicopter with the desired takeoff course at a stabilized hover of approximately 3 feet (skid height). Apply forward cyclic smoothly and gradually while simultaneously increasing collective pitch to begin a coordinated acceleration and climb. Adjust pedal as necessary to maintain the desired heading. Maximum torque available should be applied (without exceeding helicopter limits) as the helicopter attitude is established that will permit safe obstacle clearance. The climbout is continued at that attitude and power setting until the obstacle is cleared. After the obstacle is cleared, adjust helicopter attitude and collective pitch as required to establish a climb at the desired rate and airspeed. Continuous coordinated application of control pressures is necessary to maintain trim, heading, flight path, airspeed, and rate of climb. Takeoff may be made from the ground by positioning the cyclic control slightly forward of neutral prior to increasing collective pitch.

b. Level Acceleration. Align the helicopter with takeoff course at a stabilized hover of approximately 3 feet (skid height). Apply forward cyclic smoothly and gradually while simultaneously increasing collective pitch to begin an acceleration at approximately 3 to 5 feet skid height. Adjust pedal to maintain heading. Maximum torque available should be applied (without exceeding helicopter limits) prior to accelerating through effective translational lift. Additional forward cyclic pressure will be necessary to allow for level acceleration to the desired climb airspeed. Approximately 5 knots prior to reaching the desired climb airspeed, gradually release forward cyclic pressure and allow the helicopter to begin a constant airspeed climb to clear the obstacle. Care must be taken not to decrease airspeed during the climbout since this may result in the helicopter descending (falling through). After the obstacle is cleared, adjust helicopter attitude and collective pitch as required to establish desired rate of climb and airspeed. Continuous coordinated application of control is necessary to maintain trim, heading, flight path, airspeed, and rate of climb. Takeoff may be made from the ground by positioning the cyclic control slightly forward of neutral prior to increasing collective pitch.

c. The two techniques give approximately the same distance over a 50-foot obstacle when the helicopter can just hover OGE. As hover capability is decreased, the level acceleration technique gives increasingly shorter distances than the coordinated climb technique. Where the two techniques yield the same distance over a 50-foot obstacle, the coordinated climb technique will give a shorter distance over lower obstacles and the level acceleration technique will give a shorter distance over obstacles higher than 50 feet. In addition to the distance comparison, the main advantages of the level acceleration technique are as follows: (1) It requires less or no time in the avoid area of the height velocity diagram; (2) peformance is more repeatable; (3) at the higher climbout airspeeds (30 knots or more), reliable indicated airspeeds are available for accurate airspeed reference from the beginning of the climbout, therefore minimizing the possibility of fall-through. The main advantage of the coordinated climb technique is that the climb angle is established early in the takeoff and more distance and time are available to abort the takeoff if the obstacle cannot be cleared.

8-27. BEFORE LANDING.

1. GUNNER PLT OVRD switch—OFF.
2. MASTER ARM switch—STBY.
3. TCP—TSU/GUN.
4. Searchlight—As required.

8-28. AFTER LANDING.

1. Searchlight—As required.
2. Transponder—As required.

8-29. ENGINE SHUTDOWN.

1. Throttle—Reduce to idle. Allow TGT to stabilize for two minutes.
2. FORCE TRIM switch—FORCE TRIM.
3. ★ Armament systems—OFF and set as follows:
    a. TOW BLOW circuit breaker—OUT.
    b. TCP switch—OFF.
    c. MASTER ARM switch—OFF.
    d. HSS linkage—STOW.
    e. TURRET DEPR LIMIT switch—DEPR LIMIT.
    f. M73 sight—OFF.
4. Systems—Check and turn off as follows:
    a. DEICE switch—OFF.
    b. SCAS POWER switch—OFF.
    c. ECU panel switches—OFF.
    d. Engine, transmission, and electrical indications—Check indications.
    e. Avionics and mission equipment—OFF.
    f. Lights—Set as required.
5. Throttle—OFF.

CAUTION

If a rapid rise in TGT is noted, press the starter switch to motor the engine (throttle closed) stabilizing temperature within limits.

6. ENGINE and PWR panel switches—Set as follows:
    a. FUEL switch—OFF.
    b. INV switch—OFF.
    c. GEN switch—OFF.
7. Collective accumulator—Check as follows:
    a. EMER COLL HYD switch—OFF. Attempt to raise collective. If collective cannot be raised, the accumulator is functioning properly.
    b. EMER COLL HYD switch—ON. Move collective full up and down one stroke, then OFF.

c. Gunner EMER COLL HYD switch—ON. Move collective full up and down one stroke. This indicates that the gunner's EMER COLL HYD switch is working properly. Continue to bleed the accumulator with short strokes from the down position to prevent the collective from stopping in the up position. If collective stops in up position, rotate the main rotor in the normal direction of rotation and simultaneously move the collective to the down position.

d. Gunner's EMER COLL HYD switch—OFF.

8. BAT switch—OFF.

9. IGNITION switch—OFF. Remove key as required.

10. Both canopy removal arming/firing mechanism safety pins—In.

8-30. BEFORE LEAVING HELICOPTER.

WARNING

When helicopter is to be parked where ambient temperature equals or exceeds 32 degrees C, the fire extinguisher shall be removed until the next mission.

1. Post flight—Check for damage, fluid leaks and levels.

2. Mission equipment—Secure.

★ 3. All armament—Check as follows:

a. Wing ejector rack jettison safety pins—Installed.

b. TOW missile arming lever—Up (if missiles are installed).

c. Rocker igniter arms—In contact with rockets to reduce possibility of ignition from electromagnetic interference (EMI).

4. Complete all forms and records. An entry on DA Form 2408-13 is required if any of the following conditions were experienced:

a. Flown in a loose grass environment.

b. Operated within 10 nautical miles of salt water.

c. Operated within 200 nautical miles of volcanic activity.

d. Exposed to radioactivity.

5. Secure helicopter.

Section III. INSTRUMENT FLIGHT

8-31. INSTRUMENT FLIGHT PROCEDURES.

This helicopter is not qualified for operation under instrument meteorological conditions although adequate navigation and communications equipment are installed for instrument flight. Flight characteristics and range are the same during instrument flight conditions as operations in visual flight conditions. Refer to FM 1-240, FM 1-300, AR 95-1, and FAR Part 91 for instrument flight rules and weather information.

Section IV. FLIGHT CHARACTERISTICS

8-32. OPERATING CHARACTERISTICS.

The flight characteristics of this helicopter, in general, are similar to other single rotor helicopters.

8-33. ROLLOVER CHARACTERISTICS.

Refer to FM 1-203, Fundamentals of Flight.

8-34. BLADE STALL.

a. General. In forward flight, some portions of the rotor disk swept by the retreating blade are always stalled. How this stalled area affects the performance and flying qualities depends on the size of the stalled area. The size of the stalled area increases with increase in gross weight, airspeed, density altitude, "g" loading, or with a decrease in rpm. The rolling and pitching motion which is often associated with rotor stall will not occur.

b. Stall Recognition. The pilot will notice a progressive increase in vertical vibration level, mostly at 2 per rev, as more of the rotor disk becomes stalled. An increase in any of the above stall-inducing factors will result in higher 2 per rev vibration and eventually the onset of control force feedback. Both the 2 per rev vibration and feedback forces will be progressively greater as blade stall affects more of the rotor area. Because of the progressive nature of blade stall with this rotor system, there is no abrupt threshold or onset of rotor stall and therefore no meaningful "stall limit" exists.

c. Stall Reduction.

(1) The amount of stall and associated vibration encountered may be reduced by reducing collective.

(2) Reducing the g loading of the maneuver may be accomplished by applying:

(a) Forward cyclic.

(b) Reducing airspeed.

(c) Increasing operating rpm.

(d) Reducing altitude.

8-35. CONTROL FEEDBACK.

a. Feedback in the cyclic stick or collective stick is caused by high loads in the control system. These loads are generated during severe maneuvers and can be of sufficient magnitude to overpower or feed through the main boost cylinders and into the cyclic and/or collective stick. The pilot will feel this feedback as an oscillatory "shaking" of the controls even though he may not be making control inputs after the maneuver is established. This type of feedback will normally vary with the severity of the maneuver. The pilot should regard it as a cue that high control system loads are occurring and should immediately reduce the severity of the maneuver.

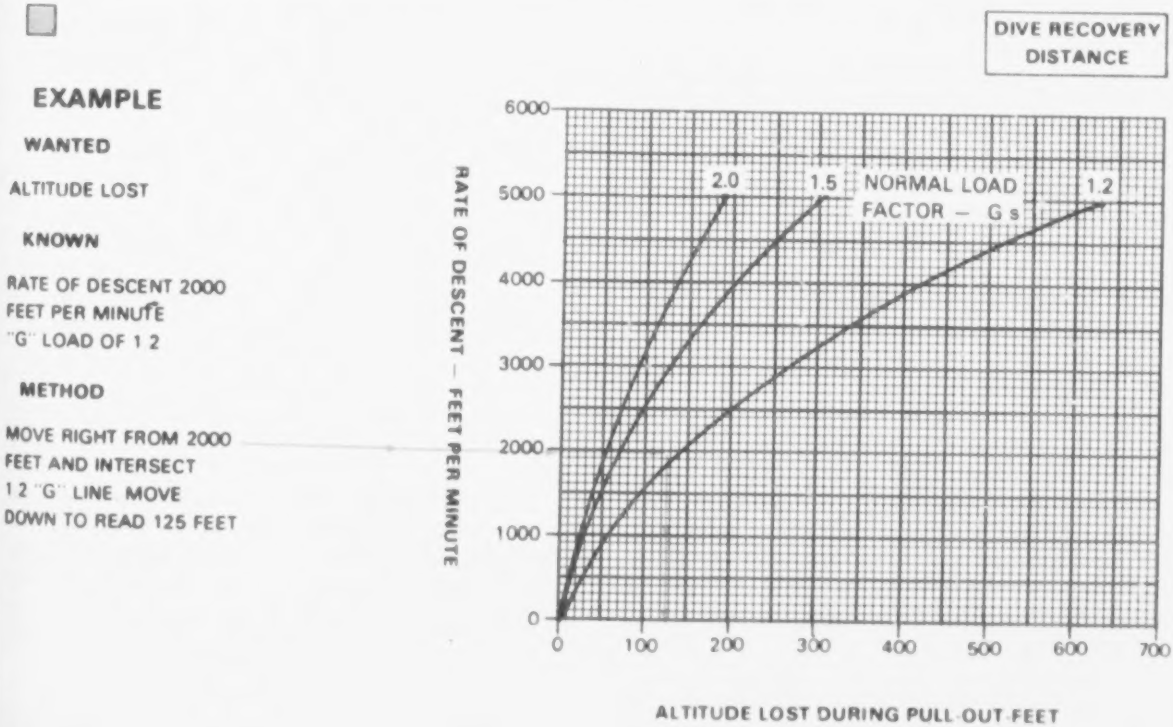
b. The gunner station side arm flight controls are designed for emergency conditions and have a reduced mechanical advantage. Because of this reduced mechanical advantage of the gunner's cyclic and collective control, severe maneuvers should be avoided while flying from the gunner station.

8-36. DIVING FLIGHT.

WARNING

If an abrupt recovery is attempted at speeds near VNE, "mushing" of the helicopter can occur. If mushing is experienced, do not increase collective, as this will aggravate the condition. Figure 8-3 depicts the altitude lost during a pullout versus rate of descent for various g loadings.

Diving flight presents no particular problems in the helicopter; however, the pilot should have a good understanding of such things as rates of descent versus airspeed, rate of closure, and rates of descent versus power. The helicopter gains airspeed quite rapidly in a dive and it is fairly easy to exceed VNE. Rates of descent of 3500 ft./min. to 4800 ft./min. are not uncommon during high-speed dives. High rates of descent coupled with high



EXAMPLE

WANTED

ALTITUDE LOST

KNOWN

RATE OF DESCENT 2000 FEET PER MINUTE
"G" LOAD OF 1.2

METHOD

MOVE RIGHT FROM 2000 FEET AND INTERSECT 1.2 "G" LINE. MOVE DOWN TO READ 125 FEET

Figure 8-3. Dive recovery distances

flight path speeds require that the pilot monitor both rate of closure and terrain features very closely and plan his dive recovery in time to avoid having to make an abrupt recovery.

8-37. POWER DIVES.

At speeds above the maximum level flight speed, the rate of descent will increase approximately 1000 ft./min. for every 10 knots increase in airspeed for the full power condition.

8-38. PITCH CONE COUPLING.

a. Pitch cone coupling is the characteristic of the rotor to inherently reduce blade pitch with increasing coning under loading which aids to maintain rpm and retard blade stall. With severe rotor loading, the rotor rpm may overspeed above the red line unless collective pitch is increased.

b. When g load is placed upon the rotor system through steep turns, dive recoveries, or other high-stress maneuvers, the rotor blades cone upward. Most of the inherent bending action is absorbed by the flexible yoke assembly. As the hub bends, the pitch change horns exert a downward pressure on the pitch control tubes. The control tubes, however, are fixed through the control system and are unable to move. As pressure continues to be applied, the leading edge of the blade begins to rotate downward via the feather bearing. This directly reduces pitch in the blades which in turn acts to increase rotor rpm. As the rotor rpm begins to increase, the N2 governor senses the change and begins to decrease engine power, resulting in a corresponding decrease in torque and N1. When performing g maneuvers, maintaining a constant torque setting is of prime importance in preventing overspeeding of the rotor.

8-39. TRANSIENT TORQUE.

a. Transient torque, although evident in all semi-rigid single-rotor system helicopters, is a phenomenon which is quite pronounced in the AH-1S. With a rapid application of left lateral cyclic, a rapid torque increase followed by a decrease will be evidenced. This condition occurs as a result of temporary increased induced drag being placed on the rotor system by the additional pitch in the advancing blade.

b. With a rapid application of right lateral cyclic, a rapid torque decrease followed by an increase will be evidenced. This condition occurs as a result of drag being reduced in the rotor system due to the reducing of pitch in the advancing blade, which temporarily decreases the blade's resistance to the airflow. Increasing and decreasing rotor system drag will produce corresponding torque changes due to the fact that the rotor system requirement for an increase or decrease in power is sensed and subsequently supplied by the fuel control system. As airspeed and severity of the maneuver are increased, the transient torque effect is also increased. The pilot should become familiar with this characteristic and form a natural tendency to compensate with collective control to avoid exceeding the helicopter torque and rotor rpm limitations.

8-40. MANEUVERING FLIGHT.

During left rolling maneuvers or high power dives, torque increases occur. To prevent main transmission overtorque, care must be exercised in monitoring torque pressure to enable the pilot to reduce power as required to prevent overtorque.

8-41. LOW G MANEUVERS.

WARNING

Intentional flight below +0.5 "g's" is prohibited.

Abrupt inputs of the flight controls cause excessive main rotor flapping, which may result in mast bumping and must be avoided.

If an abrupt right roll should occur when rapidly lowering the nose, PULL IN AFT CYCLIC to stop the rate and effect recovery. Left lateral cyclic WILL NOT effect recovery from a well-developed right roll during flight at less than one g, and it may cause severe main rotor flapping. DO NOT move collective or directional controls or disengage the SCAS during recovery.

a. Because of mission requirements, it may be necessary to rapidly lower the nose of the helicopter in order to (1) acquire a target; (2) stay on target; or (3) recover from a pullup. At moderate to high airspeeds, it becomes increasingly easy to approach zero or negative load factors by abrupt forward cyclic inputs. The helicopter may exhibit a tendency to roll to the right simultaneously with the forward cyclic input; this characteristic being most pronounced when roll SCAS is disengaged.

b. Such things as sideslip, weight and location of wing stores and airspeed will affect the severity of the right roll. Variances in gross weight, longitudinal cg, and rotor rpm may affect the roll characteristics. The right roll occurs throughout the normal operating airspeed range and becomes more violent at progressively lower load factors.

NOTE

When it is necessary to rapidly lower the nose of the helicopter, it is essential that the pilot monitor changes in roll attitude as the cyclic is moved forward.

8-42. SETTLING WITH POWER.

Refer to FM 1-203, Fundamentals of Flight.

8-43. ROTOR RPM—POWER OFF.

The following steps list the factors which affect power-off rotor rpm.

a. Airspeed. In autorotation, rotor rpm varies with airspeed. Maximum rotor rpm is achieved at a steady state of 60 to 80 knots (figure 8-4). Rotor rpm decreases at stabilized airspeeds above or below 60- to 80-knot range. When changing airspeeds, cyclic movement will produce a rotor rpm other than that produced under steady-state conditions as follows:

(1) *From low airspeed.* Example: From a stabilized 30-knot autorotative condition, a positive forward cyclic movement to increase airspeed will cause the rotor rpm to decrease initially and then increase when the helicopter is stabilized at the higher speed.

(2) *From high airspeed.* Example: From a stabilized 120 KIAS autorotative condition, a positive aft cyclic movement to decrease airspeed will cause the rotor rpm to increase initially and then decrease when the helicopter is stabilized at the lower speed.

b. Gross Weight. The power-off rotor rpm varies significantly with gross weight. A low gross weight will produce a low rotor rpm. A high gross weight will produce a high rotor rpm. With the collective system correctly rigged to a minimum blade angle (full down collective stick), the pilot must manually control rpm with the col-

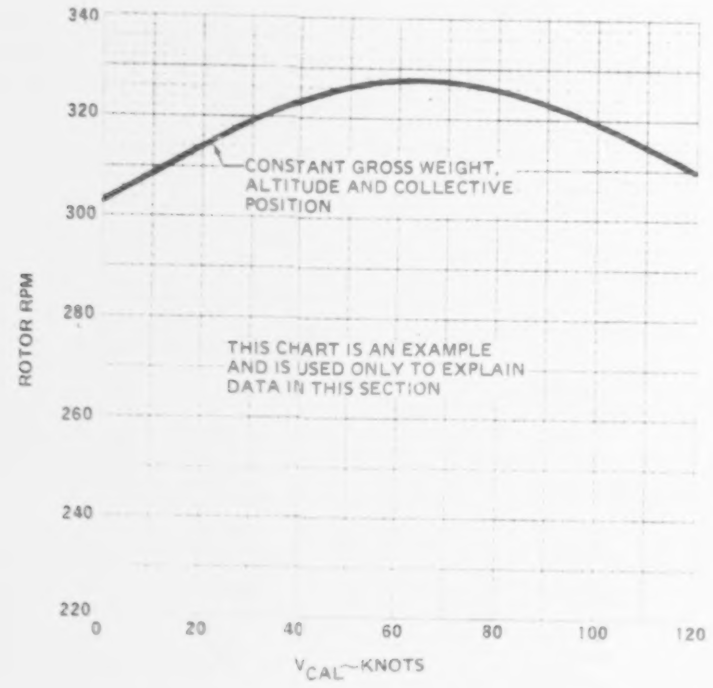


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Figure 8-4. Main rotor rpm versus airspeed

lective stick in order to prevent overspeed of the rotor when at high gross weight.

8-44. AUTOROTATION CHARACTERISTICS.

*a. **Rotor Speed.*** The K747 main rotor blades have a greater tendency to overspeed in autorotation than the B540 main rotor blades.

b. Refer to FM 1-230, Fundamentals of Flight, Section IV, Autorotation.

8-45. MAST BUMPING.

WARNING

Abrupt inputs of the flight controls cause excessive main rotor flapping, which may result in mast bumping and must be avoided.

a. Mast bumping (flapping-stop contact) is the main rotor yoke contacting the mast. It may occur during slope landings, rotor start-up/coast-down, or when the approved flight envelope is exceeded. If mast bumping is encountered in flight, land as soon as possible.

(1) If mast bumping occurs during a slope landing, reposition the cyclic control to stop the bumping and reestablish a hover.

(2) If mast bumping occurs during start-up or shut-down, move cyclic to minimize or eliminate bumping.

(3) If mast bumping occurs during rearward or sideward flight, move cyclic slightly toward center position and apply pedal to bring the nose into the relative wind.

b. Because of mission requirements, it may be necessary to rapidly lower the nose of the helicopter with cyclic input or make a rapid collective reduction. At moderate to high airspeeds, it becomes increasingly easy to approach less than +0.5 "g's" by abrupt forward cyclic inputs. Variance in such things as sideslip, airspeed, gross weight, density altitude, center of gravity, and rotor speed may increase main rotor flapping and increase the probability of mast bumping. Rotor flapping is a normal part of maneuvering and excessive flapping can occur at greater than 1 "g" flight; but, flapping becomes more excessive for many given maneuvers at progressively lower load factors.

(1) In the event of loss of all engine power at high speed, aft cyclic must be applied to maintain rotor rpm and to avoid mast bumping during autorotation entry.

(2) If the flight envelope is inadvertently exceeded by low g flight (below +0.5g), move the cyclic aft to regain positive thrust on the rotor before correcting rolling tendencies.

Section V. ADVERSE ENVIRONMENTAL CONDITIONS

8-46. GENERAL.

This section provides information relative to operation under adverse environmental conditions (snow, ice and rain, turbulent air, extreme cold and hot weather, desert operations, mountainous and altitude operation) at maximum gross weight. Section II check list provides for operational requirement of this section.

8-47. COLD WEATHER OPERATIONS.

Operation of the helicopter in cold weather or an arctic environment presents no unusual problems if the operators are aware of those changes that do take place and conditions that may exist because of the lower temperatures and freezing moisture.

a. Inspection. The pilot must be more thorough in the walk-around check when temperatures have been at or below 0 degrees C (32 degrees F). Water and snow may have entered many parts during operations or in periods when the helicopter was parked unsheltered. This moisture often remains to form ice which will immobilize moving parts or damage structure by expansion and will occasionally foul electric circuitry. Protective covers afford major protection against rain, freezing rain, sleet, and snow when installed on a dry helicopter prior to precipitation. Since it is not practical to completely cover an unsheltered helicopter, those parts not protected by covers and those adjacent to cover overlap and joints require closer attention, especially after a blowing snow or freezing rain. Accumulation of snow and ice should be removed prior to flight. Failure to do so can result in hazardous flight, due to aerodynamic and center of gravity disturbances as well as the introduction of snow, water, and ice into internal moving parts and electrical systems. The pilot should be particularly attentive to the main and tail rotor systems and their exposed control linkages.

CAUTION

At temperatures of −35 degrees C (−31 degrees F) and lower, the grease in the spherical couplings of the main and tail rotor transmission driveshafts and tail-rotor driveshaft coupling may congeal to a point that the couplings cannot operate properly. If temperature is −44 degrees C (−47 degrees F) or below the pilot must be particularly careful to monitor engine instruments for high oil pressure.

b. Transmission. Check for proper operation by turning the main rotor opposite to the direction while an observer watches the driveshaft to see that there is no tendency for the transmission to "wobble" while the driveshaft is turning. If found frozen, apply heat (do not use open flame and avoid overheating boot) to thaw the spherical couplings before attempting to start engine.

c. Checks.

(1) Before exterior check 0 degrees C (32 degrees F) and lower. Perform check as specified in Section II.

(2) Exterior check 0 degrees C (32 degrees F) to −54 degrees C (−65 degrees F). Perform exterior check as outlined in Section II, plus the following checks.

(a) Surfaces and controls—Check free of ice and snow. Deicing fluid or heat should be used to remove ice.

(b) Fluid levels—Contraction of the fluids in the helicopter system at extreme low temperature causes indication of low levels. A check made just after the previous shutdown and carried forward to the walkaround check is satisfactory if no leaks are in evidence. Filling when the system is cold will reveal an overfull condition immediately after flight, with the possibility of forced leaks at seals.

(c) Engine Air Inlet—Remove all loose snow that could be pulled into and block the engine intake during starting.

(3) Interior check—All flights 0 degrees C (32 degrees F) to −54 degrees C (−65 degrees F). Perform check as specified in Section II.

(4) Interior check—Night flights 0 degrees C (32 degrees F) to −54 degrees C (−65 degrees F). Perform check as specified in Section II.

(5) Engine starting check—0 degrees C (32 degrees F) to −54 degrees C (−65 degrees F).

CAUTION

As the engine cools to an ambient temperature below 0 degrees C (32 degrees F) after engine shutdown, condensed moisture may freeze engine seals. Ducting hot air from an external source through the air inlet housing will free a frozen rotor. Perform check as outlined in Section II. During cold weather, starting the engine oil pressure gage will indicate maximum (100 psi). The engine should be warmed up at engine idle until the engine oil pressure indication is below 100 psi.

(6) Hydraulic filter indicators—Reset if popped out.

(7) Engine runup check. Perform the check as outlined in Section II.

WARNING

Control system checks should be performed with extreme caution when helicopter is parked on snow and ice. There is reduction in ground friction holding the helicopter stationary, controls are sensitive and response is immediate.

d. Engine Starting Without External Power Supply. If a battery start must be attempted when the helicopter and battery have been at temperatures between −26 degrees C to −37 degrees C (−15 degrees F to −35 degrees F), preheat the engine and battery if equipment is available and time permits. Preheating will result in a faster starter cranking speed which tends to reduce hot start hazard by assisting the engine to reach a self-sustaining speed (40 percent N1) in the least possible time.

8-48. SNOW.

Refer to FM 1-202, Environmental Flight.

8-49. DESERT AND HOT WEATHER OPERATION.

Refer to FM 1-202, Environmental Flight.

8-50. TURBULENCE AND THUNDERSTORMS.

Flight in thunderstorms and heavy rain which accompanies thunderstorms should be avoided. If turbulence and thunderstorms are encountered inadvertently, use the following procedures:

a. Check that safety belts and harnesses are tightened.

b. PITOT HTR—ON.

c. Power—Adjust to maintain a penetration speed of 100 KIAS or VNE whichever is slower.

d. Radios—Turn volume down on any radio equipment badly affected by static.

e. At night—Turn interior lights to full bright to minimize blinding effect of lightning.

f. Maintain a level attitude and constant power setting. Airspeed fluctuations should be expected and disregarded.

g. Maintain the original heading, turning only when necessary.

h. The altimeter is unreliable due to differential barometric pressures within the storm. An indicated gain or loss of several hundred feet is not uncommon and should be allowed for in determining minimum safe altitude.

8-51. ICING CONDITIONS.

WARNING

Intentional flight in known moderate or greater icing conditions is prohibited. If icing conditions are encountered during flight, every effort should be made to vacate the icing environment.

WARNING

Firing of aircraft weapons in icing conditions is prohibited. The weapons covered are: TOW missile, 2.75 inch FFAR, 40MM Grenade Launcher, 20 MM gun, and 7.62MM MG. A very serious safety hazard exists if aircraft weapons are fired in icing weather conditions. The TOW missile warhead can detonate in close proximity to aircraft. The warhead fuse is damaged as missile is launched through ice in missile launcher. Gun barrels and breeches can rupture if gun muzzles are clogged with ice. The FFAR are held captive in the launcher tubes by the frozen ice.

CAUTION

When operating at FAT of 5°C (40°F) or below, icing of the engine air particle separator and FOD screens can be expected. Continued accumulation of ice will result in partial or complete power loss.

Continuous flight in light icing conditions is not recommended because the ice shedding induces rotor blade vibrations, adding greatly to the pilot's work load.

a. If icing conditions become unavoidable, the pil should turn the PITOT HEAT, ENVR CONT and D ICE switches on.

b. During icing conditions, one or all of the following can be expected to occur:

(1) Obscured forward field of view due to ice accumulation on the canopy. If the ECU fails to keep the canopy clear of ice, the side windows may be used for visual reference during landing.

(2) One-per-rotor-revolution vibrations ranging from mild to severe caused by asymmetrical ice shedding from the main rotor system. The severity of the vibration will depend upon the temperatures and the amount of ice accumulation on the blades when the ice shed occurs. The possibility of an asymmetric ice shed occurring increases as the outside air temperature decreases. Severe vibrations may occur as a result of main rotor asymmetrical ice shedding. If icing conditions are encountered while in flight, land as soon as practicable. All ice should be removed from the rotor system before attempting further flight.

(3) An increase in torque required to maintain a constant airspeed and altitude due to ice accumulation on the rotor system.

(4) Possible degradation of the ability to maintain autorotational rotor speed within operating limits.

c. Control activity cannot be depended upon to remove ice from the main rotor system. Vigorous control movements should not be made in an attempt to reduce low-frequency vibrations caused by asymmetrical shedding of ice from the main rotor blades. These movements may induce a more asymmetrical shedding of ice, further aggravating helicopter vibration levels.

d. If a 5 psi (or greater) torque pressure increase is required above the cruise torque setting used prior to entering icing conditions, it may not be possible to maintain autorotational rotor speed within operational limits, should an engine failure occur.

WARNING

Ice shed from the rotor blades and/or other rotating components presents a hazard to personnel during landing and shutdown. Ground personnel should remain well clear of the helicopter during landing and shutdown and passengers/crewmembers should not exit the aircraft until the rotor has stopped turning.

8-52. RAIN.

WARNING

Rain removal system does not remove rain in flight.

DIVE RECOVERY DISTANCE

EXAMPLE

WANTED

ALTITUDE LOST

KNOWN

RATE OF DESCENT 2000
FEET PER MINUTE
"G" LOAD OF 1.2

METHOD

MOVE RIGHT FROM 2000
FEET AND INTERSECT
1.2 "G" LINE. MOVE
DOWN TO READ 125 FEET

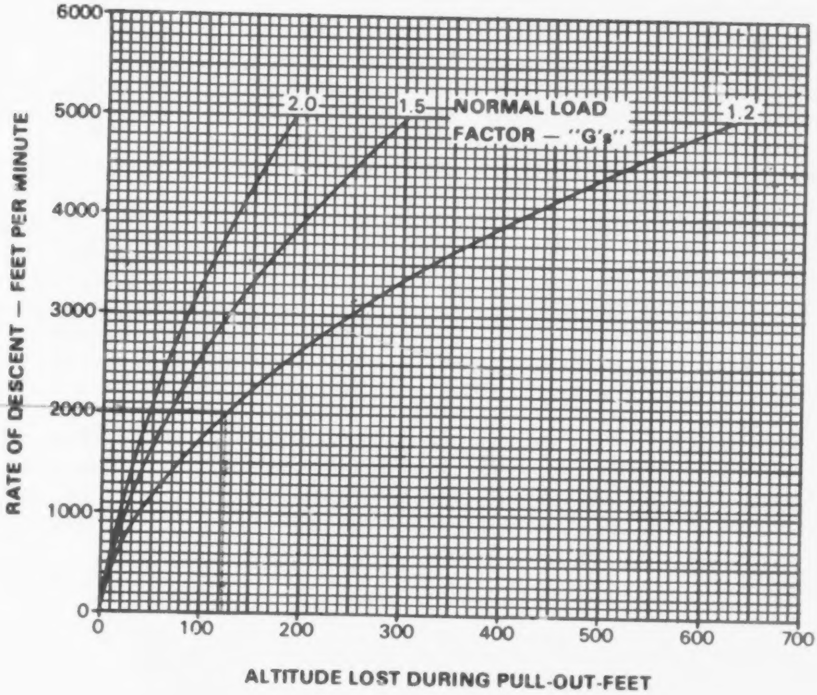

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Figure 8-4. Dive recovery distances

8-68. TRANSIENT TORQUE.

a. Transient torque, although evident in all semi-rigid single rotor system helicopters, is a phenomenon which is quite pronounced in the AH-1S. With a rapid application of left lateral cyclic a rapid torque increase followed by a decrease will be evidenced. This condition occurs as a result of temporary increased induced drag being placed on the rotor system by the additional pitch in the advancing blade.

b. With a rapid application of right lateral cyclic a rapid torque decrease followed by an increase will be evidenced. This condition occurs as a result of drag being reduced in the rotor system due to the reduction of pitch in the advancing blade, which temporarily decreases the blade's resistance to the airflow. Increasing and decreasing rotor system drag will produce corresponding torque changes due to the fact that the rotor system's requirement for an increase or decrease in power is sensed and subsequently supplied by the fuel control system. As airspeed and severity of the maneuver are increased, the transient torque effect is also increased. The pilot should become familiar with this characteristic and form a natural tendency to compensate with collective control to avoid exceeding the helicopter torque and rotor rpm limitations.

8-69. MANEUVERING FLIGHT.

During left rolling maneuvers or high power dives torque increases occur. To prevent main transmission overtorque, care must be exercised in monitoring torque pressure to enable the pilot to reduce power as required to prevent overtorque conditions.

8-70. LOW "G" MANEUVERS.

WARNING

Intentional flight below + 0.5 "G's" is prohibited.

Abrupt inputs of the flight controls cause excessive main rotor flapping, which may result in mast bumping and must be avoided.

WARNING

If an abrupt right roll should occur when rapidly lowering the nose, PULL IN AFT CYCLIC to stop the rate and effect recovery. Left lateral cyclic WILL NOT effect recovery from a well developed right roll during flight at less than one "g" and it may cause severe main rotor flapping. DO NOT move collective or directional controls or disengage the SCAS during recovery.

Because of mission requirements, it may be necessary to rapidly lower the nose of the helicopter in order to (1) acquire a target; (2) stay on target; or (3) recover from a pullup. At moderate to high airpseeds, it becomes increasingly easier to approach zero or negative load factors by abrupt forward cyclic inputs. The helicopter may exhibit a tendency to roll to the right simultaneously with the forward cyclic input; this characteristic being most pronounced when roll SCAS is disengaged.

Such things as sideslip, weight and location of wing stores, and airspeed will affect the severity of the right roll. Variances in gross weight, longitudinal cg, and rotor rpm may affect the roll characteristics. The right roll occurs throughout the normal operating airspeed range and becomes more violent at progressively lower load factors.

NOTE

When it is necessary to rapidly lower the nose of the helicopter, it is essential that the pilot monitor changes in roll attitude as the cyclic is moved forward.

8-70A. MAST BUMPING.

WARNING

Abrupt inputs of the flight controls cause excessive main rotor flapping, which may result in mast bumping and must be avoided.

Mast bumping (flapping-stop contact) is the main rotor yoke contacting the mast. It may occur during slope landings, rotor start-up/coast-down, or when the approved flight envelope is exceeded. If mast bumping is encountered in flight, land as soon as possible.

If bumping occurs during a slope landing, reposition the cyclic to stop the bumping and reestablish a hover.

If bumping occurs during startup or shutdown, move cyclic to minimize or eliminate bumping.

Figure 8-4A represents a matrix of flight maneuvers which produce high flapping and the flight conditions which amplify flapping. For example, because of mission requirements, it may be necessary to rapidly lower the nose of the helicopter with cyclic input or make a rapid collective reduction. At moderate to high airspeeds it becomes increasingly easy to approach less than + 0.5 "G's" by abrupt forward cyclic inputs. Variance in such things as sideslip, airspeed, gross weight, density altitude, center of gravity, and rotor speed may increase main rotor flapping and increase the probability of mast bumping. Rotor flapping is a normal part of maneuvering and excessive for many given maneuvers at progressively lower load factors

If the flight envelope is inadvertently exceeded, causing a low "G" condition and right roll, move cyclic aft to return rotor to a positive thrust condition, then roll level, continuing flight if mast bumping has not occurred.

As collective pitch is reduced after engine failure or loss of tail rotor thrust, cyclic must be positioned to maintain positive "G" forces during autorotation. Touchdown should be accomplished prior to excessive rotor RPM decay.

8-71. HOVERING CAPABILITY.

Refer to Chapter 7 for hover performance. Chapter 5 contains information on hover limitations.

8-72. SETTLING WITH POWER.

a. Settling with power is sometimes described as "settling in your own downwash". This phrase is in reality, quite descriptive since the helicopter finds itself entering air which has just previously been accelerated downward by the rotor. Settling

	AMPLIFY FLAPPING					
PRODUCE HIGH FLAPPING	LOW ROTOR SPEED	NEAR C. G. LIMITS	HIGH GROSS WEIGHT	LARGE OR RAPID CYCLIC INPUTS	HIGH DENSITY ALTITUDE	UNCOORDINATED FLIGHT
HIGH SPEED FLIGHT	X	X	X	X	X	X
REDUCED "G" FLIGHT				X		X
ROLL REVERSAL		X	X	X		X
SIDEWARD/REARWARD FLIGHT		X		X		
SLOPE LANDINGS	X		X	X	X	
CONTOUR FLIGHT		X		X		X

Figure 8-4A. Factors Causing High Flapping Angles Which May Result in Mast Bumping.

best copy available

with power is a transient condition of downward flight during which an appreciable portion of the main rotor system is being forced to operate at angles of attack above maximum. Tuft studies show that blade stall starts in near the hub and progresses outward along the blade as the rate of descent increases. The application of collective pitch and power results only in stalling more of the blade area and producing an even more rapid descent rate. It follows that since inboard portions of the blades are stalled, cyclic control response will be reduced accordingly.

b. "Settling" can be quite hazardous if inadvertently entered near the ground. Rates of descent exceeding 2200 feet per minute have been recorded during this state of flight. The characteristics of settling are very similar to the "feel" of stall in a conventional aircraft (Roughness in the airframe and controls and some loss of control effectiveness). The recovery procedure is also approximately the same, i.e., drop the nose and accelerate into forward flight. Recovery can also be made by reducing collective to the minimum which will almost immediately result in vertical autorotation. This procedure, however, results in considerable altitude loss.

8-73. ROTOR RPM — POWER OFF.

The following steps list the factors which affect power-off rotor rpm.

a. Airspeed. In autorotation, rotor rpm varies with airspeed. Maximum rotor rpm is achieved at a steady state of 60 to 80 knots (Figure 8-5). Rotor rpm decreases at stabilized airspeeds above or below 60 to 80 knot range. When changing airspeeds, cyclic movement will produce a rotor rpm other than that produced under steady state conditions as follows:

(1) From low airspeed. Example: From a stabilized 30 knot autorotative condition, a positive forward cyclic movement to increase airspeed will cause the rotor rpm to decrease initially and then increase when the helicopter is stabilized at the higher speed.

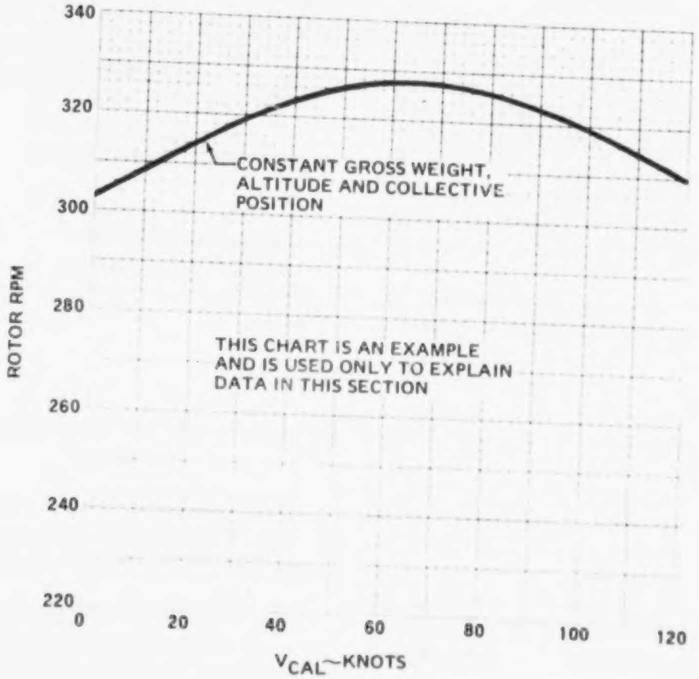

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Figure 8-5. Main rotor rpm versus airspeed

(2) From high airspeed. Example: From a stabilized 120 KIAS autorotative condition, a positive aft cyclic movement to decrease airspeed will cause the rotor rpm to increase initially and then decrease when the helicopter is stabilized at the lower speed.

b. Gross Weight. The power-off rotor rpm varies significantly with gross weight. A low gross weight will produce a low rotor rpm. A high gross weight will produce a high rotor rpm. With the collective system correctly rigged to a minimum blade angle (full down collective stick) of approximately 8.5 degrees, the pilot must manually control rpm with the collective stick in order to prevent overspeed of the rotor when at high gross weight.

8-74. LEVEL FLIGHT CHARACTERISTICS.

The level flight characteristics of this helicopter are normal throughout the operating limits range. All control response is immediate and gives positive results.

8-75. AUTOROTATION CHARACTERISTICS.

The following steps explain the necessity of maintaining the rotor rpm in its normal range.

a. Normal Rotor Speed. The normal rotor speed assures the pilot that he will retain adequate control effectiveness. Low rpm (underspeed) causes a proportional loss of response to control inputs. High rpm (overspeed) can cause structural damage to the rotor system.

b. Rotor Flapping. The angle between the tip path plane and the mast increases at low rpm. By maintaining rotor rpm in the normal range, the pilot assures safe clearance between the rotor and the tailboom.

c. Rotor Inertia. Rotor inertia is a characteristic which tends to prolong the effectiveness of collective control in the autorotation landing. This effectiveness decreases with rpm. Normal rotor rpm assures the pilot that he will have normal inertia and normal collective control response with which to arrest the sink rate in the autorotation landing. The minimum blade angle rigging is dictated by the minimum autorotation rpm requirement (295) when at light gross weight and low altitude.

d. Density Altitude. The power off rotor rpm varies with altitude; low altitude - low rpm; high altitude - high rpm. For the same flight conditions as in step a., the pilot will find that the higher the altitude - the higher the collective stick position required to prevent overspeed of the rotor.

e. Cyclic Flare. Aft cyclic control application (nose up pitching) produces an increase in rotor rpm proportional to the flare and entry speed. The higher the speed the greater the flare effectiveness. From a high speed entry condition, a steep flare can produce an overspeed unless limited by collective pitch control.

8-76. PILOT TECHNIQUE.

It can be readily seen from the foregoing information, that the pilot technique must vary in accordance with the actual conditions of airspeed, altitude, and gross weight at the time of engine failure.

Section V. ADVERSE ENVIRONMENTAL CONDITIONS

This section provides information relative to operation under adverse environmental conditions (snow, ice and rain, turbulent air, extreme cold and hot weather, desert operations, mountainous and altitude operation) at maximum gross weight. Section II check list provides for operational requirement of this section.

8-77. COLD WEATHER OPERATIONS.

Operation of the helicopter in cold weather or an arctic environment presents no unusual problems if the operators are aware of those changes that do take place and conditions that may exist because of the lower temperatures and freezing moisture.

a. Inspection. The pilot must be more thorough in the walk-around inspection when temperatures have been at or below 0°C (32°F). Water and snow may have entered many parts during operations or in periods when the helicopter was parked unsheltered. This moisture often remains to form ice which will immobilize moving parts or damage structure by expansion and will occasionally foul electric circuitry. Protection covers afford majority protection against rain, freezing rain, sleet, and snow when installed on a dry helicopter prior to the precipitation. Since it is not practicable to completely cover an unsheltered helicopter, those parts not protected by covers and those adjacent to cover overlap and joints require closer attention, especially after a blowing snow or freezing rain. Accumulation of snow and ice should be removed prior to flight. Failure to do so can result in hazardous flight, due to aerodynamic and center of gravity disturbances as well as the introduction of snow, water, and ice into internal moving parts and electrical systems. The pilot should be particularly attentive to the main and tail rotor systems and their exposed control linkages.

CAUTION

At temperatures of -35°C (-31°F) and lower, the grease in the spherical couplings of the main transmission driveshaft and tail rotor driveshaft couplings may congeal to a point that the couplings cannot operate properly. If found frozen, apply heat to thaw the couplings before attempting to start the engine. Indication of proper operation is obtained by turning the main rotor blade opposite to the direction of rotation while observer watches the driveshaft to see that there is no tendency for the transmission to "wobble" while the driveshaft is turning.

CAUTION

If temperature is —44°C (—47°F) or below the pilot must be particularly careful to monitor engine instruments for high oil pressure.

b. Checks.

(1) Before exterior check 0°C (32°F) and lower. Perform check as specified in Section II.

(2) Exterior check 0°C (32°F) to —54°C (—65°F). Perform exterior check as outlined in Section II, plus the following checks.

CAUTION

Check that all surfaces and controls are free of ice and snow.

NOTE

Contraction of the fluids in the helicopter system at extreme low temperature causes indication of low levels. A check made just after the previous shutdown and carried forward to the walk around check is satisfactory if no leaks are in evidence. Filling when the system is cold-soaked will reveal an over-full condition immediately after flight, with the possibility of forced leaks at seals.

(a) Main Rotor — Check free of ice, frost, and snow.

(b) Engine air inlet — Remove all loose snow that could be pulled into and block the engine intake during starting.

(3) Interior check — all flights 0°C (32°F) to —54°C (—65°F). Perform check as specified in Section II.

(4) Interior check — night flights 0°C (32°F) to —54°C (—65°F). External Power connected. Perform check as specified in Section II.

(5) Engine starting check 0°C (32°F) to —54°C (—65°F). Determine that the compressor rotor turns freely. As the engine cools to an ambient temperature below 0°C (32°F) after engine shutdown condensed moisture may freeze engine seals. Ducting hot air from an external source through the air inlet housing will free a frozen rotor. Perform check as outlined in Section II.

NOTE

During cold weather starting the engine oil pressure gage will indicate maximum (100 psi). The engine should be warmed up at engine idle until the engine oil pressure indication is below 100 psi. The time required for warmup is entirely dependent on the starting temperature of the engine and lubrication system.

(6) Hydraulic filter indicators — Reset if popped out.

(7) Engine runup check. Perform the check as outlined in Section II.

WARNING

Control system checks should be performed with extreme caution when helicopter is parked on snow and ice. There is reduction in ground friction holding the helicopter stationary, controls are sensitive and response is immediate.

c. Engine Starting Without External Power Supply. If a battery start must be attempted when the helicopter and battery have been cold-soaked at temperatures between —26°C to —37°C (—15°F to —35°F), preheat the engine and battery if equipment is available and time permits. Preheating will result in a faster starter cranking speed which tends to reduce the hot start hazard by assisting the engine to reach a self-sustaining speed (40% N1) in the least possible time.

8-78. SNOW.

a. Takeoff. Snow takeoff may be considered normal except for the following precautions that should be observed.

WARNING

Under cold weather conditions, make sure all instruments have sufficient warm up time to ensure normal operation. Check for sluggish instruments before takeoff.

(1) Select an area that is free of loose or powdery snow to minimize the restriction to visibility from blowing snow.

WARNING

Due to air starvation, snow and ice accumulation during ground operation may be detrimental to the engine and hazardous to the helicopter and crew. Ground operation time should be minimized and FOD screen and particle separator must be inspected prior to takeoff.

(2) Before attempting to takeoff make sure the landing gear skids are free and not frozen to the surface.

(3) The first takeoff after a cold start should include a visual check of the ground surface for evidence of hydraulic leaks. This should be done under hovering power conditions. If hydraulic leaks are present, abort the mission.

b. Landing — Snow. Snow landing may be considered normal except for the following precautions that should be observed:

(1) Select an area free of loose or powdery snow so that visibility will not be restricted by blowing snow.

(2) Accomplish a normal landing to the ground. Limited visibility will result from swirling snow, when hovering is attempted before making a touchdown.

(3) Anticipate loose powdery snow and crusts on all landings on snow.

(4) Landings should always be made when visual ground reference can be maintained. The reference point should be kept forward and to the right so that it will be visible to the pilot at all times.

NOTE

When making an approach and landing on snow it should be one continuous operation without extended hover in order to reduce the white-out condition that results from extended hovering over snow. This white-out will usually occur on loose snow and can cause the pilot to lose all reference with the ground or any object he is approaching. If the object being used as reference should become completely obscured, accomplish a go-round.

8-79. DESERT AND HOT WEATHER OPERATION.

Problems encountered in desert operation are blowing dust/sand and high ambient temperature.

a. Blowing dust and sand obscure vision. All takeoffs and landings should be made from or to the ground.

b. High ambient temperature affect helicopters performance. Refer to Chapter 7.

8-80. TURBULENCE AND THUNDERSTORMS.

Flight in thunderstorms and heavy rain which accompanies thunderstorms should be avoided. If turbulence and thunderstorms are encountered inadvertently, use the following procedures:

a. Check that safety belts and harnesses are tightened.

b. Pitot heat — ON.

c. Power — Adjust to maintain a penetration speed of 100 KIAS.

NOTE

The turbulence penetration speed is 100 KIAS.

d. Radios — Turn volume down on any radio equipment badly affected by static.

e. At night — Turn interior lights to full bright to minimize blinding effect of lightning.

f. Maintain a level attitude and constant power setting. Airspeed fluctuations should be expected and disregarded.

g. Maintain the original heading, turning only when necessary.

h. The altimeter is unreliable due to differential barometric pressures within the storm. An indicated gain or loss of several hundred feet is not uncommon and should be allowed for in determining minimum safe altitude.

8-81. ICING CONDITIONS.

WARNING

Firing of aircraft weapons in icing conditions is prohibited. The weapons covered are: TOW missile, 2.75 inch FFAR, 40MM Grenade Launcher, 20MM Gun and 7.62MM MG.

A very serious safety hazard exists if aircraft weapons are fired in icing weather conditions. The TOW missile warhead can detonate in close proximity to aircraft. The warhead fuse is damaged as missile is launched through ice in missile launcher. Gun barrels and breechs can rupture if gun muzzles are clogged with ice. The FFAR are held captive in the launcher tubes by the frozen ice.

CAUTION

Continuous flight in light icing conditions is not recommended because the ice shedding induces rotor blade vibrations, adding greatly to the pilots workload.

During flight in icing conditions, the pilot can expect one or all of the following to occur.

a. At any temperature below freezing, a low frequency main blade vibration, caused by asymmetric self-shedding ice.

b. To maintain airspeed, the torque must be increased.

c. An increase in engine TGT.

SECTION VI - CREW DUTIES

8-82. PASSENGER BRIEFING.

The following is a guide that should be used in accomplishing required passenger briefings, when a unit passenger briefing is not available. Items that do not pertain to specific mission may be omitted.

a. Crew Introduction

b. Equipment

    (1) Personal to include ID tags.
    (2) Professional.
    (3) Survival.

c. Flight Data

    (1) Route.
    (2) Altitude.
    (3) Time en route.
    (4) Weather.

d. Normal Procedures

    (1) Entry and exit of aircraft.
    (2) Seating.
    (3) Seat belts.
    (4) Movement in aircraft.
    (5) Internal communications.
    (6) Security of equipment.
    (7) Smoking.
    (8) Oxygen.
    (9) Refueling.
    (10) Weapons.
    (11) Protective masks.
    (12) Parachutes.

e. Emergency Procedures

    (1) Emergency exits.
    (2) Emergency equipment.
    (3) Emergency landing/ditching procedures.
    (4) Bail out.

GPO 817-685

CHAPTER 9
EMERGENCY PROCEDURES

Section I. HELICOPTER SYSTEMS

9-1. HELICOPTER SYSTEMS.

This section describes the helicopter systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency operation of mission equipment is contained in this chapter insofar as its use affects safety of flight. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the condensed checklist, TM 55-1520-234-CL.

9-2. IMMEDIATE ACTION EMERGENCY STEPS.

WARNING

To obtain maximum protection from the restraint system during an emergency landing, each crewmember should place their shoulders against the seat back, manually lock the shoulder harness, and keep back straight.

NOTE

The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is helicopter control. All procedures are subordinate to this requirement. The MASTER CAUTION should be reset after each malfunction to allow systems to respond to subsequent malfunctions. If time permits during a critical emergency, transmit a MAY DAY CALL, set transponder to emergency, jettison external stores (if appropriate), and lock shoulder harnesses.

Those steps that must be performed immediately in an emergency situation are underlined. These steps must be committed to memory and performed without reference to the checklist. Emergency situations with non-underlined steps may be accomplished with use of the checklist.

9-3. DEFINITION OF EMERGENCY TERMS.

For the purpose of standardization, these definitions shall apply.

a. The term "LAND AS SOON AS POSSIBLE" is defined as landing at the nearest suitable landing area (e.g., open field) without delay. (The primary consideration is to ensure the survival of occupants.)

b. The term "LAND AS SOON AS PRACTICABLE" is defined as landing at a suitable landing area. (The primary consideration is the urgency of the emergency.)

c. The term "AUTOROTATE" is defined as adjusting the flight controls as necessary to establish an autorotational descent and landing.

1. Collective—Adjust as required to maintain rotor RPM.
2. Pedals—Adjust as required.
3. Throttle—Adjust.
4. Airspeed—Adjust as required.
5. (O) Wing stores—Jettison as appropriate.

d. The term "EMER SHUTDOWN" is defined as engine shutdown without delay.

1. Throttle—OFF.
2. FUEL switch—OFF.
3. BAT switch—OFF.

e. The term "EMER GOV OPNS" is defined as manual control of the engine RPM with the GOV AUTO/EMER switch in the EMER position. Because automatic acceleration, deceleration, and overspeed control are not provided with the GOV switch in the EMER position, throttle and collective coordinated control movements must be smooth to prevent compressor stall, overspeed, overtemperature, or engine failure.

CAUTION

No more than 42 psi torque is available in the EMER position due to limited fuel flow and may be significantly reduced based on ambient conditions.

1. GOV switch—EMER.

2. Throttle—Adjust as necessary to control RPM

3. Land as soon as possible.

f. The term "JETTISON CANOPY" is defined as activation of the linear explosive canopy removal system to remove windows and separate doors from the helicopter. Emergency exits are shown in Figure 9-1.

1. Arming/firing mechanism handle—Turn 90°.

2. Arming/firing mechanism handle—Pull.

WARNING

Simultaneous or near simultaneous pulling of both the pilot's and gunner's arming/firing mechanism handle may result in injury to one or both of the crewmembers. The pilot must coordinate with the gunner prior to system firing.

9-4. AFTER EMERGENCY ACTION.

After a malfunction of equipment has occurred, appropriate emergency actions have been taken and the helicopter is on the ground, an entry shall be made in the Remarks Section of DA Form 2408-13 describing the malfunction. Ground and flight operations shall be discontinued until corrective action has been taken.

9-5. EMERGENCY ENTRANCE.

Crew removal is accomplished through the crew doors or through the windows with crash rescue equipment.

9-6. EMERGENCY EQUIPMENT.

Emergency equipment consists of a fire extinguisher, first aid kit, and linear explosives canopy removal system. (Refer to Figure 9-1.) Wing store jettison capability is provided by explosive cartridges installed at each wing store pylon.

9-7. MINIMUM RATE OF DESCENT.

The speed for minimum rate of descent is 60 KIAS.

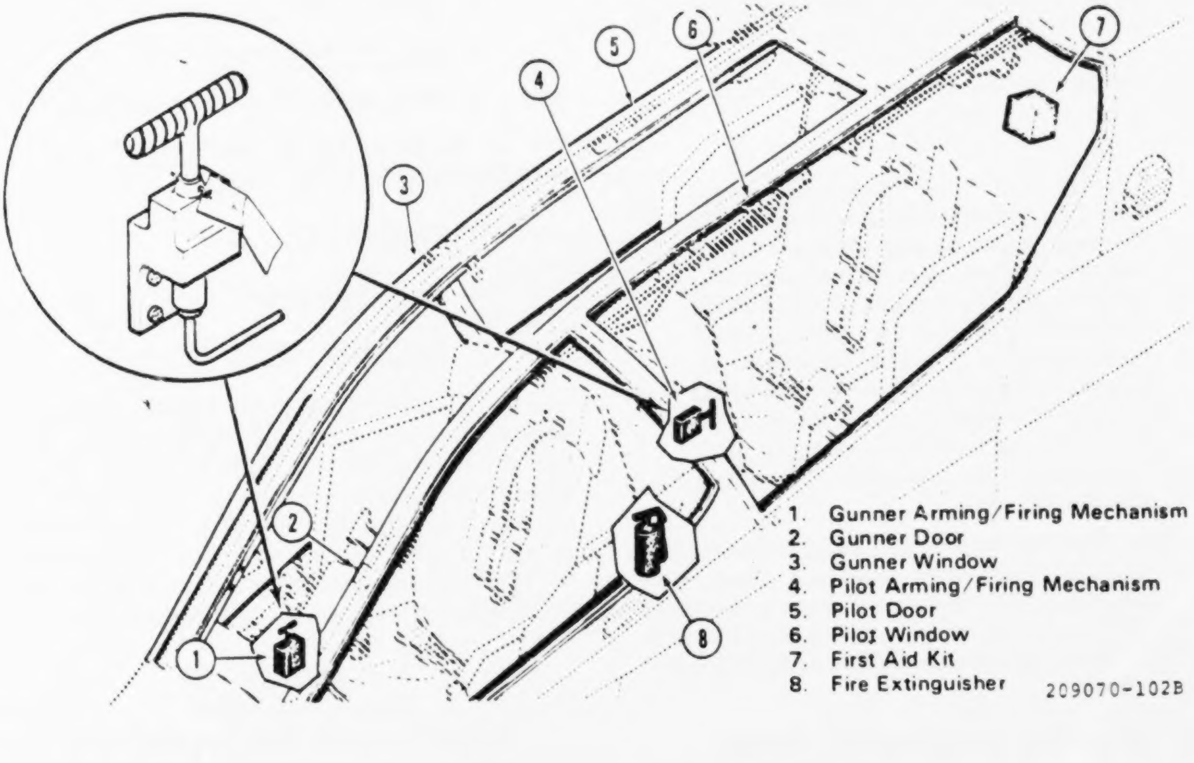
1. Gunner Arming/Firing Mechanism
2. Gunner Door
3. Gunner Window
4. Pilot Arming/Firing Mechanism
5. Pilot Door
6. Pilot Window
7. First Aid Kit
8. Fire Extinguisher
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Figure 9-1. Emergency exits and equipment

WARNING

Do not close the throttle. Prior to reducing collective after RPM warning audio and light activation, first verify the engine failure by cross checking other indications.

When a loss of engine power is detected, it is necessary to decrease the collective pitch and apply right pedal immediately in order to avoid a reduction in rotor RPM and to maintain a constant heading. An exception to this statement occurs during engine failures above 120 KIAS. Under partial power conditions the engine may operate relatively smooth at reduced power or it may operate roughly and erratically with intermittent surges of power. In instances where a power loss is experienced without accompanying engine roughness or surging, the helicopter may sometimes be flown in a gradual descent at reduced power to a more favorable landing area; however, under these conditions the pilot should always be prepared for a complete power failure an an immediate autorotative landing. In the event that a partial power condition is accompanied by engine roughness, erratic operation or power surging, take immediate action by closing the throttle completely and accomplish an

9-8. MAXIMUM GLIDE DISTANCE.

The speed for best glide distance is 100 KIAS (clean configuration) and 90 KIAS (wing stores).

9-9. ENGINE.

9-10. ENGINE MALFUNCTION-PARTIAL OR COMPLETE POWER LOSS.

a. The indications of an engine malfunction, either a partial or a complete power loss are left yaw, drop in engine rpm, drop in rotor rpm, drop in N1, low rpm audio alarm, illumination of the rpm warning light, change in engine noise.

WARNING

Do not respond to the rpm audio and/or warning light illumination without first confirming engine malfunction by one or more of the other indications. Normal indications signify the engine is functioning properly and that there is a tachometer generator failure or an open circuit to the warning system, rather than an actual engine malfunction.

b. Partial power loss. Under partial power conditions, the engine may operate relatively smoothly at reduced power or it may operate erratically with intermittent surges of power. A stabilization of the N1 should indicate a partial power condition. In instances where a power loss is experienced without accompanying power surging, the helicopter may sometimes be flown at reduced power to a favorable landing area. Under these conditions, the pilot should always be prepared for a complete power loss. In the event a partial power condition is accompanied by erratic engine operation or power surging, and flight is to be continued, perform EMER GOV operations. If continued flight is not possible, AUTOROTATE (throttle off).

c. Complete power loss.

(1) Under a complete power loss condition, delay in recognition of the malfunction, improper technique or excessive maneuvering to reach a suitable landing area reduces the probability of a safe autorotational landing. Flight conducted within the caution area of the height-velocity chart (fig. 9-2) exposes the helicopter to a high probability of damage despite the best efforts of the pilot.

(2) From conditions of low airspeed and low altitude, the deceleration capability is limited, and caution should be used to avoid striking the ground with the tail rotor. Initial collective reduction will vary after an engine malfunction dependent upon the altitude and airspeed at the time of the occurrence. For example, collective pitch must not be decreased when an engine failure occurs at zero airspeed and approximately 15 feet; whereas, during cruise flight conditions, altitude and airspeed are sufficient for a significant reduction in collective pitch, thereby, allowing rotor rpm to be maintained in the safe operating range during autorotational descent. At high gross weights, the rotor may tend to overspeed and require collective pitch application to maintain the rpm below the upper limit. Collective pitch should never be applied to reduce rpm below normal limits for extending glide distance because of the reduction in rpm available for use during autorotational landing.

(3) Through a speed range of 120 to 190 KIAS, an engine failure will cause the nose of the helicopter to pitch up as a result of its aerodynamic qualities. The SCAS system detects this airframe movement and will attempt to correct with a forward cyclic control input, thereby causing serious rotor flapping and possible mast bumping. To prevent SCAS from making this correction there must be pilot input. In a nose-low attitude or level flight, the input should be aft cyclic movement. In a nose-high attitude, such as dive pullout, the input should be a forward cyclic movement. During the recovery from a high-speed engine failure, the important point to remember is to maintain the necessary rotor rpm and movement to keep the rotor system loaded. Speed should be reduced to successfully reach the intended landing area. After entering autorotation, follow standard autorotation procedures. Do not exceed 120 KIAS in sustained autorotation.

CAUTION

Engine failure at 150 KIAS and greater requires a pilot recognition and reaction time of less than one second to preclude unacceptable high left roll rates. Heavy buffeting of the tailboom and vertical fin and heavy control feedback during recovery are associated with engine failure at high speed and high power conditions.

9-11. ENGINE MALFUNCTION - HOVER.

AUTOROTATE

9-12. ENGINE MALFUNCTION—LOW ALTITUDE/LOW AIRSPEED OR CRUISE.

1. AUTOROTATE.
2. EMER GOV OPNS.

MINIMUM HEIGHT FOR SAFE LANDING AFTER ENGINE FAILURE
324 ROTOR RPM

MINIMUM HEIGHT
AH-1S
T53-L-703

EXAMPLE A

WANTED

CALIBRATED AIRSPEED
INDICATED AIRSPEED

KNOWN

DENSITY ALTITUDE SEA LEVEL
SKID HEIGHT ABOVE GROUND 410 FEET

METHOD

ENTER SKID HEIGHT HERE
MOVE RIGHT TO DENSITY ALTITUDE
MOVE DOWN. READ CALIBRATED
AIRSPEED 42 KNOTS
CONTINUE DOWN. READ INDICATED
AIRSPEED 40 KNOTS

EXAMPLE B

WANTED

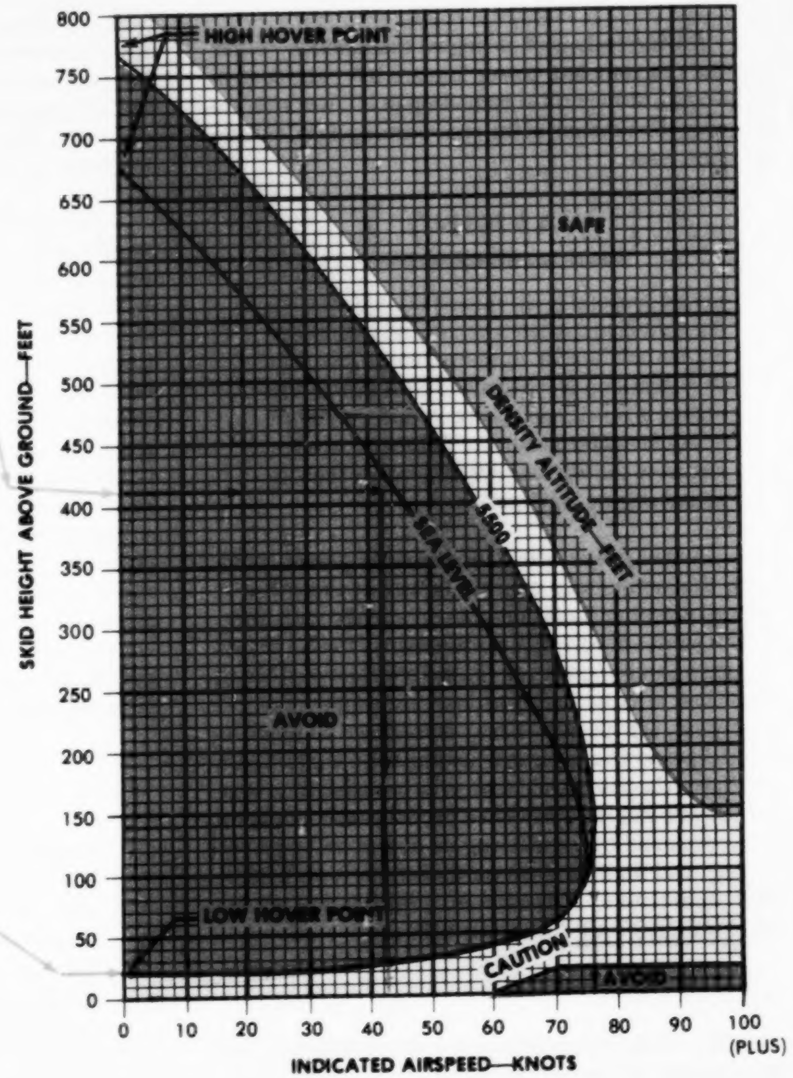
MINIMUM INDICATED AIRSPEED
FOR CLIMBOUT TO AVOID
HEIGHT VELOCITY RESTRICTIONS

KNOWN

DENSITY ALTITUDE 5500 FEET
LOW HOVER POINT 20 FEET
SKID HEIGHT ABOVE GROUND

METHOD

ENTER DENSITY ALTITUDE HERE
(AT LOW HOVER POINT)
MOVE RIGHT ALONG THE
DENSITY ALTITUDE LINE
TO THE FASTEST AIRSPEED
MOVE DOWN. READ INDICATED
AIRSPEED 73 KNOTS



DATA BASIS DERIVED FROM FLIGHT TEST USA ASTA 69-13 FEBRUARY 1971

Figure 9-2. Minimum height for safe landing after engine failure chart

9-13. ENGINE MALFUNCTION--120 KIAS AND ABOVE.

1. CYCLIC—Adjust.

2. AUTOROTATE.

3. EMER GOV OPNS.

9-14. Deleted.

9-15. DROOP COMPENSATOR FAILURE.

Droop compensator failure will be indicated when engine rpm is no longer controlled by application of collective pitch. The engine will tend to overspeed as collective pitch is decreased and will underspeed as collective pitch is increased. If the droop compensator fails, make minimum collective movements and execute a shallow approach to the landing area. If unable to maintain the operating RPM within limits:

EMER GOV OPNS.

9-16. ENGINE COMPRESSOR STALL.

Engine compressor stall (surge) is characterized by a sharp rumble or loud sharp reports, severe engine vibration, and a rapid rise in turbine gas temperature, depending on the severity of the surge. Maneuvers requiring rapid or maximum power applications should be avoided. Should this occur:

1. Collective—Reduce.

2. RAIN REMOVAL/ENVR CONT switch—OFF.

3. DE-ICE switch—OFF.

4. Land as soon as possible.

9-17. INLET GUIDE VANE ACTUATOR FAILURE.

a. If the guide vanes fail in the closed position, a maximum of 20-25 psi torque will be available. Although N1 may indicate normal, power applications above 20-25 psi will result in deterioration of N2 and rotor rpm while increasing N1. Placing the GOV switch in the EMER position will not provide any increased power capability and increases the possibility of an N1 overspeed and an engine overtemperature. Should a failure occur, land as soon as practicable to an area that will permit a run-on landing with minimum power applications.

b. If the inlet guide vanes fail in the open position during normal flight, it is likely that no indications will be experienced. As power applications are made from increasingly lower N1 settings, acceleration times will correspondingly increase, and the possibility of a compressor stall is likely. Should this failure occur, land as soon as practicable to an area that will permit a run-on landing.

9-18. ENGINE OVERSPEED.

Engine overspeed will be indicated by a right yaw, rapid increase in both rotor and engine rpm, rpm warning light illuminated, and an increase in engine noise. An engine overspeed may be caused by a malfunctioning N2 governor or fuel control. If an overspeed is experienced:

1. Collective—Increase to load the rotor in an attempt to maintain rpm below the maximum operating limit.

2. Throttle—Reduce to normal operating rpm. If rpm cannot be controlled:

3. EMER GOV OPNS.

9-19. ROTORS, TRANSMISSION, AND DRIVE SYSTEMS.

9-20. TAIL ROTOR FAILURE—FLIGHT.

Because of the many different malfunctions that can occur, it is not possible to provide a solution for every emergency. The success in coping with the emergency depends on quick analysis of the condition and selection of the proper emergency procedure. The following is a discussion of some types of malfunctions, probable effects, and corrective actions.

a. Complete Loss of Thrust Components.

(1) *Complete Loss of Tail Rotor Thrust.* This is a situation involving a break in the drive system, such as a severed driveshaft, wherein the tail rotor stops turning and no thrust is delivered by the tail rotor. A failure of this type in powered flight will usually result in the nose of the helicopter swinging to the right (left side slip) and usually a roll of the

fuselage. Nose down tucking will also be present. If powered flight is possible, continue to a suitable landing area and AUTOROTATE (throttle off), and coordinate the resulting maneuver with cyclic control. The most advisable procedure, if further flight is not possible, is to immediately AUTOROTATE (throttle off). The pilot should expect that some rotation will be present until touchdown. Touchdown should be in as level an attitude as possible and ground speed as low as possible to minimize turnover.

(2) *Loss of Tail Rotor Components.* Except for a more severe nose tuck due to the forward cg shift, this situation would be quite similar to a complete loss of thrust as discussed above. When a loss of components is suspected, AUTOROTATE (throttle off).

b. Fixed Pitch Failure.

(1) *General.* Failures of this type (wedged control, jammed slider, etc.) are characterized by either a lack of directional response when a pedal is pushed or the pedals will be in a locked position. At approximately 100 KIAS and above, the cambered vertical fin will begin to become more effective and as a result, a left yaw condition will increase and conversely, a right yaw will decrease. To aid in directional control, the rpm may be decreased with the throttle until rpm is controlled manually. Increasing the throttle and/or collective will move the nose to the right, decreasing the throttle and/or collective will move the nose to the left.

WARNING

If the pedals cannot be moved with a moderate amount of force, do not attempt a maximum effort since a more serious malfunction and set of circumstances could result.

(2) *Left fixed pitch.* If it has been determined the tail rotor pitch is fixed in a left pedal applied position, an autorotative landing should not be attempted. The pilot should use only that power necessary to produce a controllable degree of side slip and continue to the nearest suitable landing area. To accomplish a landing, establish a powered approach with an airspeed that will allow a desirable rate of descent without producing an uncomfortable left yaw attitude and right side slip condition. Just prior to landing, adjust throttle and collective as necessary to align the helicopter with touchdown.

(3) *Right fixed pitch.* If the tail rotor becomes fixed during cruise flight or a reduced-power situation, the helicopter will yaw to the right when power is increased. For either of these situations, a running type landing can be performed. If the right yaw becomes excessive when adding power at touchdown, reduce the throttle and cushion the landing with collective. The greatest problem is the compromise that may have to be made between rate of descent and yaw attitude since the collective is the primary control for both of these parameters.

9-21. TAIL ROTOR FAILURE—HOVER.

a. If the tail rotor pitch is fixed in a left pedal position, simultaneously reduce throttle and gradually increase collective pitch to land the helicopter.

b. If total loss of tail rotor thrust/fixed right pedal is experienced:

1. Throttle—Reduce.
2. AUTOROTATE.

9-22. MAIN DRIVESHAFT FAILURE.

A failure of the main driveshaft will be indicated by a left yaw (this is caused by the drop in torque applied to the main rotor), increase in engine rpm, decrease in rotor rpm, low rpm audio alarm, and illumination of the rpm warning light. This condition will result in complete loss of power to the rotor and a possible engine overspeed. If a failure occurs:

1. AUTOROTATE.
2. Throttle—Off.

9-23. TRANSMISSION SPRAG CLUTCH MALFUNCTION.

9-24. CLUTCH FAILS TO DISENGAGE

A clutch failing to disengage in flight will be indicated by the rotor rpm decaying with engine rpm as the throttle is reduced to the engine idle position when entering autorotational descent. This condition results in total loss of autorotational capability. If a failure occurs:

1. Throttle—On.
2. Land as soon as possible.

9-25. CLUTCH FAILS TO RE-ENGAGE.

During recovery from autorotational descent, clutch malfunction may occur and will be indicated by a reverse needle split (engine rpm higher than rotor rpm).

1. AUTOROTATE.

2. Throttle–Off.

9-26. FIRE.

The safety of helicopter occupants is the primary consideration when a fire occurs. On the ground, it is essential that the engine be shut down, crew evacuated, and fire fighting begun immediately. If the helicopter is airborne when a fire occurs, the most important single action that can be taken by the pilot is to land the helicopter.

9-27. FIRE—ENGINE START.

The following procedure is applicable during engine starting if TGT limits are exceeded, or if it becomes apparent that they will be exceeded. Flames emitting from the tailpipe are acceptable if the limits are not exceeded.

1. Throttle–Off.

2. FUEL switch–OFF.

3. Start switch–Press until TGT is in the normal operating range.

9-28. FIRE—GROUND.

a. Pilot's station.

EMER SHUTDOWN.

b. Gunner's station.

1. IDLE STOP–RELEASE and hold.

2. Throttle–OFF.

3. ELEC PWR switch–EMER OFF.

9-29. FIRE-FLIGHT.

If the fire light illuminates and/or fire is observed during flight, prevailing circumstances (such as VFR, IMC, night, altitude, and landing areas available), must be considered in order to determine whether to execute a power-on (max–Vne), or a power-off landing (max–120 KIAS).

a. Power-On.

1. Land as soon as possible.

2. EMER SHUTDOWN.

b. Power-Off.

1. AUTOROTATE.

2. EMER SHUTDOWN.

9-30. ELECTRICAL FIRE-FLIGHT.

Prior to shutting off all electrical power, the pilot must consider the equipment that is essential to a particular flight environment that will be encountered; e.g., flight instruments and fuel boost pumps. In the event of electrical fire or suspected electrical fire in flight:

1. BAT switch–ON.

2. Electrical switches–OFF.

3. NON-ESS BUS switch–NORMAL.

4. Land as soon as possible.

5. EMER SHUTDOWN.

If landing cannot be made as soon as possible and flight must be continued, the defective circuits may be identified and isolated. Electrical switches should be turned ON one at a time in the priority required. When malfunctioning circuit is identified, turn switch off.

9-31. FUMES FROM ECU.

If fumes are emitted in the cockpit from the ECU System:

1. ENVR CONT switch–OFF.

If fumes continue:

2. Land as soon as possible.

9-32. SMOKE AND FUME ELIMINATION.

1. Vents–Open.

2. Airspeed–Reduce to 40 KIAS or below.

3. Canopy doors–Open to intermediate position.

9-33. SINGLE OR DUAL FUEL BOOST PUMP FAILURE.

Continued flight below 6000 feet or less pressure altitude is permitted.

Single or dual pump failure.

1. Fuel switch–ON.

2. Pump circuit breaker(s)—OUT.

3. Land as soon as practicable.

CAUTION

Nose-down attitudes greater than 15 degrees should be avoided because engine failure may occur due to fuel starvation when the forward fuel boost pump is inoperable and with less than 320 pounds of fuel remaining.

9-34. ELECTRICAL SYSTEM.

9-35. DC GENERATOR FAILURE—DC GENERATOR CAUTION LIGHT ILLUMINATION.

NOTE

As battery voltage is depleted there is a possibility of activation of the RPM warning light and RPM audio systems.

1. GEN BUS RESET/GEN FIELD circuit breakers—IN.

2. GEN switch—Move to RESET then to GEN position.

If generator is not restored, continue as follows:

3. GEN switch—OFF.

4. TCP MODE SEL switch—OFF.

5. Switches—OFF for unused equipment.

6. NON ESS BUS switch—As required.

9-36. AC INVERTER FAILURE—CAUTION LIGHT ILLUMINATION.

1. INV MAIN/STBY circuit breakers—In.

2. INV switch—STBY.

3. SCAS—Re-engage.

9-37. OVERHEATED BATTERY.

If overheated battery is suspected or detected proceed as follows:

1. BAT switch—OFF.

2. Land as soon as possible.

3. EMER SHUTDOWN.

WARNING

Do not open battery compartment and attempt to disconnect or remove overheated battery. Battery fluid will cause burns and overheated battery will cause thermal burns and may explode.

9-38. HYDRAULIC SYSTEM FAILURE.

If a hydraulic malfunction should occur below an airspeed of 40 KIAS, the pilot should turn on the emergency hydraulic accumulator (as appropriate) and land the aircraft as soon as possible. If terrain does not permit a landing, accelerate the aircraft to the best controllable airspeed above 40 KIAS and comply with the appropriate failure that has occurred.

WARNING

The ability to increase collective (torque) may be limited during a single system failure and will be limited during a dual system failure. Collective once lowered may not be able to be raised again; if altitude cannot be maintained, jettison wing stores as appropriate.

During a single system failure, do not move hydraulic test switch to failed system position. Hydraulic pressure to the good system will be interrupted.

9-39. HYDRAULIC FAILURE—SINGLE SYSTEM.

Loss of system No. 1 will result in loss of tail rotor servo, the yaw-SCAS actuator, and the ability to charge the accumulator. Loss of No. 2 hydraulic system will result in loss of pitch and roll SCAS actuators. Cyclic and collective control feedback may be evident during abrupt maneuvers.

1. EMER COLL HYD switch—OFF (pilot and gunner).

2. HYD CONT circuit breaker—In.

3. SCAS—DISENGAGE appropriate channels.

   a. No. 1 system—Yaw channel.

   b. No. 2 system—Pitch and roll channels.

position, an autorotative landing should not be attempted. The pilot should use only that power necessary to produce a controllable degree of side slip and continue to the nearest suitable landing area. An approach should then be established at an airspeed and rate of descent which will not produce uncontrollable side slip. During the approach, a right side slip condition will most probably prevail. When power is applied just prior to landing, the helicopter will yaw to the right, reducing the side slip condition.

d. If the tail rotor pitch becomes fixed during cruise flight or a reduced power situation (right pedal applied) the helicopter will yaw to the right when power is increased. For either of these situations, a running type landing can be performed. If the right yaw becomes excessive when adding power at touchdown, roll off the throttle and cushion the landing with collective. The greatest problem is the compromise that may have to be made between rate of descent and yaw attitude since the collective (power) is the primary

4. MASTER ARM switch—OFF.

5. Land as soon as practicable. A run-on landing at a speed of 50 KIAS or above is recommended.

6. EMER COLL HYD switch—ON (final approach).

NOTE

The turret will return to the stow position in elevation but will not stow in azimuth.

9-40. HYDRAULIC FAILURE—DUAL SYSTEM.

Loss of both hydraulic systems will result in loss of hydraulic pressure to the SCAS actuators, cyclic, collective, tail rotor servos, and the ability to charge the accumulator.

WARNING

During power application above 35 psi, roll oscillations may become unmanageable. If oscillations become severe, reduce collective until oscillations are manageable. Below 40 KIAS cyclic feedback forces become unmanageable.

NOTE

The turret will return to the stow position in elevation but will not stow in azimuth.

1. EMER COLL HYD switch—OFF (pilot and gunner).

2. HYD CONT circuit breaker—In.

3. SCAS—Disengage all channels.

4. MASTER ARM switch—OFF.

5. Land as soon as practicable. A run-on landing at a speed of 50 KIAS or above is recommended.

6. EMER COLL HYD switch—ON (final approach).

NOTE

When the collective pitch creeps down, turn the COLL HYD switch on and increase collective as required; then, turn the system off. This procedure can be repeated as required but must be kept to a minimum to ensure sufficient collective movement will remain at landing.

9-41. LANDING AND DITCHING.

9-42. LANDING IN TREES.

A landing in trees should be made when no other landing area is available. Select a landing area containing the least number of trees of minimum height. Decelerate to a zero ground speed at tree-top level and descend into the trees vertically, applying collective pitch as necessary for minimum rate of descent. Prior to the main rotor blades entering the tree, ensure throttle is off and apply all of the remaining collective pitch.

9-43. DITCHING—POWER ON.

If it becomes necessary to ditch the helicopter, accomplish an approach to an approximate 3-foot hover above the water and proceed as follows:

1. MASTER ARM—OFF.

2. PLT OVRD—OFF.

3. JETTISON CANOPY.

4. Gunner—Exit.

NOTE

Correct for cg shift of 2.5 to 4.0 inches when gunner exits helicopter.

5. Hover—Clear of gunner.

WARNING

Life preserver should not be inflated until clear of helicopter.

6. Throttle—Off and autorotate. Apply full collective pitch prior to the main rotor blades entering the water. Maintain a level attitude as the helicopter sinks and until it begins to roll, then apply cyclic in direction of the roll. Pilot should exit when main rotor stops.

9-44. DITCHING—POWER OFF.

If ditching is imminent, accomplish engine malfunction emergency procedures. Decelerate to zero forward speed, level helicopter and jettison canopy just prior to entering the water. Apply collective pitch as the helicopter sinks and until it begins to roll, then apply cyclic in the direction of the roll. Exit when the main rotor is stopped.

NOTE

There may be a tendency to decelerate too high over water due to depth perception.

9-45. FLIGHT CONTROL/MAIN ROTOR SYSTEM MALFUNCTIONS.

a. Failure of components within the flight control system may be indicated through varying degrees of feedback, binding, resistance, or sloppiness. These conditions should not be mistaken for hydraulic power failure.

b. Imminent failure of main rotor components may be indicated by a sudden increase in main rotor vibration and/or unusual noise. Severe changes in lift characteristics and/or balance condition can occur due to blade strikes, skin separation, shift or loss of balance weights or other material. Malfunctions may result in severe main rotor flapping. In the event of a main rotor system malfunction, proceed as follows:

WARNING

Danger exists that the main rotor system could collapse or separate from the aircraft after landing. A decision must be made whether occupant egress occurs before or after the rotor has stopped.

1. Land as soon as possible.
2. EMER SHUTDOWN.

9-46. MAST BUMPING.

If mast bumping occurs:

1. Reduce severity of maneuver.
2. Land as soon as possible.

9-47. STABILITY AND CONTROL AUGMENTATION SYSTEM (SCAS) FAILURE.

A failure of the SCAS will be evident by an abrupt change in pitch, roll, and/or yaw attitude which, when corrected by the pilot, will result in an abnormal cyclic or pedal position. When SCAS is disengaged, a second correction may be required by the pilot to return to level flight. Mast bumping may occur. SCAS off flight is limited to 100 KIAS MAXIMUM. Additionally, high power settings should be avoided when operating at airspeeds between 60 and 100 KIAS with inoperative roll and yaw SCAS channel because of instability. If a failure occurs, proceed as follows:

1. SAS REL button—Press.

If condition persists:

2. SCAS POWER switch—OFF.
3. Unaffected SCAS channels—re-engage only if power switch has not been turned off.
4. Land as soon as practicable.

9-48. BAILOUT PROCEDURES.

1. FORCE TRIM switches—TRIM.
2. Attitude—Attempt to stabilize helicopter in a shallow descent at approximately 80 KIAS.
3. JETTISON CANOPY.

WARNING

Delay opening parachute until well clear of helicopter.

4. Bailout.

9-49. IN-FLIGHT WIRE STRIKE.

Land as soon as possible.

Section II. MISSION EQUIPMENT

9-50. WING STORES EMERGENCY JETTISON.

a. Pilot Wing Stores Jettison Procedures.

1. WG ST JETTISON SELECT switch—As required.
2. WING STORES JETTISON switch—UP.

b. Gunner Wing Stores Jettison Procedures.

WING STORES JETTISON switch—UP.

9-51. TOW MISSILE EMERGENCY PROCEDURES.

a. Hangfire/misfire.

9-37. FUSELAGE FIRE — FLIGHT.

If fire is observed in any part of the helicopter during flight proceed as follows.

1. **Land immediately** — Perform a power-on approach and landing without delay.
2. **Throttle — Closed** as soon as the helicopter is on the ground.
3. **FUEL** switch — **OFF**.
4. **BAT** switch — **OFF**.
5. **Clear helicopter**.

9-38. ENGINE FIRE — FLIGHT.

9-39. LOW ALTITUDE.

If the fire is observed in or around the engine compartment during flight at low altitude, proceed as follows:

1. **Land immediately** — Perform a power-on approach and landing without delay.
2. **Throttle — Closed** as soon as the helicopter is on the ground.
3. **FUEL** Switch — **OFF**.
4. **BAT** switch — **OFF**.
5. **Clear helicopter.**

9-40. CRUISE ALTITUDE.

If fire is observed in or around the engine compartment during flight at an altitude which will permit the execution of an autorotational descent and landing, proceed as follows:

1. **Collective** pitch — **Down**; autorotate.
2. **Wing Stores — Jettison** as appropriate.

1. After landing—Ensure weapons are pointed at safe area.

2. Armament switches—OFF.

3. Engine shutdown.

4. Helicopter—Exit 90 degrees from line of fire.

b. Emergency Wire Cut. Should a power loss occur to the TOW system which causes the M65 to momentarily shut down, the system will automatically return to a ready-to-fire mode. If the TCP MODE SELECT switch is in ARMED MAN, then the gunner must press his WIRE CUT to sever the wires to the missile. If the TCP MODE SELECT switch is in ARMED AUTO, the gunner must reset the TCP MODE SELECT switch to manual and turn the MISSILE SELECT switch just fired and then press the WIRE CUT switch to sever wires to the missile just fired. If wire fails to cut, fly helicopter in a crab away from the wire. Approach and landing should be made in a crab to prevent entangling wire with helicopter.

WIRE CUT switch—Press.

c. TOW Missile Flight Motor Failure.

WIRE CUT switch—Press.

d. TOW Missile Erratic in Flight.

1. Attempt to keep missile down range.

2. Emergency wire cut if needed.

9-52. RUNAWAY GUN.

1. MASTER ARM switch—OFF.

2. PLT OVRD switch—OFF.

Table 9-1. Emergency Procedures for Caution Segments (Pilot and Gunner Caution Panels)

Light	Corrective Action
MASTER CAUTION	(No segment.) Land as soon as possible.
ENGINE OIL PRESS	Land as soon as possible.
ENGINE OIL BYPASS	Land as soon as possible.
XMSN OIL PRESS	Land as soon as possible.
XMSN OIL BYPASS	Land as soon as possible.
XMSN OIL HOT	Land as soon as possible.
ENG FUEL PUMP	Land as soon as possible.
CHIP DETECTOR	Land as soon as possible.
FUEL FILTER	Land as soon as possible.
SPARE	Land as soon as possible.
HYD PRESS #1	Refer to EMER procedure.
HYD PRESS #2	Refer to EMER procedure.
FWD FUEL BOOST	Refer to EMER procedure.
AFT FUEL BOOST	Refer to EMER procedure.
DC GENERATOR	Refer to EMER procedure.
INST INVERTER	Refer to EMER procedure.
GOV EMER	Information/System Status.
10% FUEL	Information/System Status.
IFF	Information/System Status.
EXTERNAL POWER	Close door.

3. **GEN switch — Move to RESET then to GEN position.**

4. Generator — Not restored.

   a. **Gen switch — OFF.**

   b. **GEN FIELD circuit breaker — Out.**

   c. **Switches/circuit breakers — OFF or pull for unused equipment.**

   d. **NON-ESS BUS switch — As required.**

9-56. AC INVERTER FAILURE — CAUTION LIGHT ILLUMINATION.

1. **INV MAIN circuit breaker — In.**

2. **INV STBY circuit breaker — In.**

3. **INV switch — STBY.**

4. SCAS — Re-engage.

5. **INV MAIN circuit breaker — Out.**

NOTE

Failure of the standby inverter will again illuminate the INST INVERTER caution light, then ac power is lost completely.

9-57. HYDRAULIC SYSTEM FAILURE.

Procedures for the three combinations of hydraulic failure are described in the following paragraphs.

WARNING

During a single system failure, do not move hydraulic test switch to the failed system position. Hydraulic pressure to the good system will be interrupted.

WARNING

The ability to increase collective (torque) may be limited during a single system failure and will be limited during a dual system failure. Collective once lowered may not be able to be raised again; if altitude cannot be maintained, jettison wing stores as appropriate.

CAUTION

Before further flight, the cause of hydraulic failure shall be determined and corrected.

9-58. HYDRAULIC SYSTEM NO. 1 FAILURE.

1. **EMER COLL HYD switch — OFF pilot and gunner.**

2. HYD CONT circuit breaker — In.

3. SCAS — Disengage YAW channel.

4. MASTER ARM switch — OFF.

5. **Land as soon as possible at an area that will permit a running landing.**

NOTE

Touchdown speed of 50 KIAS is recommended, terrain permitting.

6. EMER COLL HYD switch — ON (final approach).

NOTE

Loss of system No. 1 will result in loss of tail rotor boost, the directional control SCAS actuator, and the ability to charge the accumulator. Cyclic and collective control feedback may be evident during abrupt maneuvers.

9-59. HYDRAULIC SYSTEM NO. 2 FAILURE.

1. EMER COLL HYD switch — OFF pilot and gunner.
2. HYD CONT circuit breaker — In.
3. SCAS — Disengage PITCH and ROLL channels.
4. MASTER ARM switch — OFF.
5. Land as soon as possible at an area that will permit a running landing.

NOTE

Touchdown speed of 50 KIAS is recommended, terrain permitting.

6. EMER COLL HYD switch — ON (final approach).

NOTE

Loss of the No. 2 hydraulic system will result in loss of pitch and roll SCAS actuators. The turret will return to the stow position in elevation; however, it will not stow in azimuth. Cyclic and collective control feedback may be evident during abrupt maneuvers.

9-60. HYDRAULIC SYSTEM NO. 1 AND NO. 2 FAILURE.

1. EMER COLL HYD switch — OFF pilot and gunner.
2. HYD CONT circuit breaker — In.
3. SCAS — Disengage all channels.
4. MASTER ARM switch — OFF.

WARNING

Below 40 KIAS cyclic feedback forces become uncontrollable.

5. Airspeed — Maintain speed where control forces are manageable.

WARNING

During power application above 35 PSI torque, roll oscillations may become unmanageable. If roll oscillations become severe, reduce collective until control can be maintained.

6. Land as soon as possible at an area that will permit a running landing.

NOTE

Touchdown speed of 50 KIAS is recommended, terrain permitting.

CAUTION

With the EMER COLL HYD switch in the ON position, collective motion must be kept to a minimum until touchdown so that sufficient collective control remains to accomplish a landing.

7. EMER COLL HYD switch — ON (final approach).

NOTE

Loss of both hydraulic systems will result in loss of the SCAS actuators, cyclic, collective and tail rotor boost, and loss of directional control of the turret. The turret will return to the stow position in elevation; however, it will not stow in azimuth.

9-61. LANDING AND DITCHING.

9-62. EMERGENCY DESCENT.

a. Power Off.

1. Throttle — Off.
2. Collective adjust — Maintain rotor 295 — 324.
3. Cyclic adjust — Power off VNE.

NOTE

Turns will increase rate of descent.

b. Power On.

1. Collective — adjust.
2. Cyclic adjust — Main VNE.

9-63. LANDING IN TREES.

Decelerate to a zero ground speed at tree-top level and descent into the trees vertically applying collective pitch as necessary for minimum rate of descent. Prior to the main rotor blades entering the trees, apply all of the remaining collective pitch.

9-64. DITCHING — POWER ON.

(O) 1. Wing stores — Jettison

2. Airspeed — Hover.
3. MASTER ARM/PLT OVRD — OFF.
4. Arming/Firing handle — Turn 90° — Pull.
5. Gunner — Exit.

NOTE

Correct for cg shift of 2.5 to 4.0 inches when gunner exits helicopter.

6. Hover — Clear of gunner.
7. Accomplish a hovering autorotation, as helicopter settled into the water dissipate rotor rpm by holding the helicopter up and level as long as possible; if helicopter starts to roll, assist with cyclic in direction the helicopter tends to roll.
8. Exit helicopter when main rotor stops.

WARNING

Do not inflate life preserver until clear of helicopter.

9-65. DITCHING — POWER OFF.

(O) 1. Wing stores — Jettison

2. Arming/Firing handle — ARM.
3. Execute zero groundspeed autorotation. After leveling helicopter, pull handle to remove doors and windows.
4. As helicopter settles into water, dissipate rotor rpm by holding helicopter up and level as long as possible; if helicopter starts to roll, assist with cyclic in the direction of roll.
5. Exit helicopter when main rotor stops.

WARNING

Do not inflate life preserver until clear of helicopter.

9-66. FLIGHT CONTROLS.

Refer to hydraulic system failure procedures contained in this chapter.

9-67. STABILITY AND CONTROL AUGMENTATION SYSTEM (SCAS) FAILURE.

A failure of the SCAS will be evident by an abrupt change in pitch, roll, and yaw attitude which, when corrected by the pilot will result in an abnormal cyclic or pedal position. Mast bumping may occur. SCAS off flight is limited to 100 KIAS MAXIMUM. Additionally, high power settings should be avoided when operating at airspeeds between 60 and 100 KIAS with inoperative roll or yaw SCAS channel because of instability. If a failure occurs, proceed as follows:

1. SCAS REL button—Press.

2. If condition persists, SCAS Power switch—OFF.

3. After attitude and airspeed control has been re-established, the pilot may re-engage the unaffected SCAS channels.

4. Land as soon as practicable.

9-68. BAILOUT PROCEDURES.

a. Helicopter In Control.

1. FORCE TRIM switches — TRIM.

2. Attitude — Stabilize helicopter in a shallow descent at approximately 80 KIAS.

3. Wing Stores — Jettison.

4. Canopy — Jettison

WARNING

Delay opening parachute until well clear of helicopter.

5. Bailout — When ready.

b. Helicopter Out Of Control.

1. Attitude — Attempt to keep helicopter upright.

2. Door/Canopy — Open or jettison.

WARNING

Delay opening parachute until well clear of helicopter.

3. Bailout — When ready.

9-69. WING STORES EMERGENCY JETTISON.

a. Pilot wing stores jettison procedures.

(1) WG ST JETTISON SELECT switch — as required.

(2) WING STORES JETTISON switch — Up.

b. Gunner wing stores jettison procedures.

WING STORES JETTISON switch — Up.

Section II. MISSION EQUIPMENT

9-70. TOW MISSILE EMERGENCY PROCEDURES.

a. Hangfire/misfire.

1. After landing — Ensure weapons are pointed at safe area.

2. Armament switches — OFF.

3. Engine shutdown — Preform.

4. Helicopter — Exit 90° from line of fire.

b. Emergency Wire Cut.

WIRE CUT switch — Press.

9-71. RUNAWAY GUN.

1. MASTER ARM switch — OFF.

2. PLT OVRD switch — OFF.

3. DC circuit breaker — Out, affected gun.

4. WG ST ARM switch — OFF.

APPENDIX A

REFERENCES

AR 70-50	Designating and Naming Military Aircraft, Rockets, and Guided Missiles
AR 95-1	Army Aviation General Provisions and Flight Regulations
AR 95-5	Aircraft Accident Prevention Investigation and Reporting
AR 95-16	Weight and Balance – Army Aircraft
AR 385-40	Accident Reporting and Records
DA PAM 738-751	The Army Maintenance Management System (TAMMS)
FM 1-202	Environmental Flight
FM 1-203	Fundamentals of Flight
FM 1-204	Night Flight Techniques and Procedures
FM 1-230	Meteorology for Army Aviators
FM 1-240	Instrument Flying and Navigation for Army Aviators
FM 10-68	Aircraft Refueling
TB MED 251	Noise and Conservation of Hearing
TM 9-1005-257-12	Operator and Organizational Maintenance: Armament Pod, Aircraft 7.62 MM Gun: M18A1
TM 9-1090-203-12	Operator and Organizational Maintenance: Armament Subsystem, Helicopter, 7.62 MM Machine Gun – 40 MM Grenade Launcher, M28A1
TM 9-1090-203-12-1	Operator and Organizational Maintenance: Armament Sybsystem, Helicopter, Machine Gun – 40MM Grenade Launcher, M28A1E1.
TM 9-1330-208-25	Organizational, Direct Support, General Support, and Depot Maintenance: Dispenser, Grenade: Smoke XM118
TM 9-1425-473-20	Organizational Maintenance For Armament Subsystem, Helicopter TOW Missile M65
TM 10-1101	Petroleum Handling Equipment and Operation
TM 55-1500-342-23	Army Aviation Maintenance Engineering Manual – Weight and Balance (formerly TM 55-405-9)
TM 55-1520-234-CL	Operators and Crewmembers Checklist – AH-1S Helicopter

TM 750-244-1-5	Procedures for the Destruction of Aircraft and Associated Equipment to Prevent Enemy Use.
DOD FLIP	DOD Flight Information Publication (Enroute)
FAR Part 91	Flight Air Regulation Part 91

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